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NORTH CAROLINA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES



Mission Statement

The mission of the North Carolina Department of Agriculture and Consumer Services is to provide services that promote and improve agriculture, agribusiness, and forests; protect consumers and businesses; and conserve farmland and natural resources for the prosperity of all North Carolinians.

Steve Troxler
Commissioner of Agriculture
Chairman, Board of Agriculture

North Carolina Board of Agriculture



**Maurice Berry
Carter**



William Johnston



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Plant Industry Division

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ACCOMPLISHMENTS: ADMINISTRATIVE AND SUPPORT SERVICES SECTION

The NCDA&CS state appropriated budget for 2015 was \$3,637,849 and included a total staff of 83. For this fiscal year, there were significant increases in the phytosanitary fees collected by field staff. The Plant Industry Division continued its work with other organizations, both public and private, through the administration of cooperative agreements. For the period, approximately \$1,905,669 in cooperative agreements was received and administered for work with joint plant pest regulatory programs.

The Plant Industry Division, Support Operations Unit provides support for all the division's programs, including staff and maintenance of Division owned vehicles and other equipment needed for all service and regulatory programs. This unit also assists the Division with the implementation of safety/seasonal orientation.

ACCOMPLISHMENTS: PLANT PROTECTION SECTION

The mission of the Plant Protection Section is to enhance the quality of life in North Carolina by protecting agriculture and the environment from injurious plant pests, by promoting beneficial organisms, and by protecting rare native plants of the state.

We serve the people of North Carolina by:

- Protecting agricultural crops, horticultural crops and native flora, by preventing or controlling the invasion and spread of injurious insects, plant pathogens, weeds, and other pests of regulatory concern.
- Protecting honey bees by combating the spread of bee pathogens.
- Responding to constantly changing threats to crops, rare native plants, and honey bees by drafting effective and reasonable regulations and by achieving public compliance.
- Supporting agriculture, horticulture and related industries by providing inspection and export services to facilitate the movement of regulated commodities.
- Protecting rare native plants by restoring their habitats, and by propagating and restoring them to the wild.
- Promoting beneficial organisms that serve as biological controls of pest species.
- Providing outstanding service and satisfaction to all our clients.

North Carolina has an extremely wide range of climate, from near tropical along the southeast coast to winter conditions similar to southern Canada in our higher mountains in the west. Such diversity provides suitable environments for an extremely diverse flora and fauna. Extensive international air and sea transportation, both military and commercial, and an extensive Interstate Highway System increase the potential for the accidental introduction of pest organisms into North Carolina. Therefore, North Carolina's Plant Protection Section programs must deal with a wide range of organisms and host-pest interactions.

Major program activities for the period January 1 through December 31, 2015 are described in the following reports.

Apiary Inspection Program

The primary mission of the Apiary Inspection Service is to maintain a viable beekeeping industry and ensure the productivity of North Carolina's diverse agriculture. The North Carolina beekeeping industry continues to remain viable and is expanding, particularly with new hobby beekeepers. Our inspectors assist beekeepers through field inspections, educational meetings and field days, and attempt to be available to assist the beekeepers in any way necessary. Our goal is to further improve our overall inspections and ultimately, to reduce the rate of honey bee disease and pest problems.



Figure 1 European honey bee

To protect the health of our honey bee industry, permits to sell bees are required for anyone wishing to sell queens, package bees, nucs, or hives. In 2015, 72 permits were issued to sellers in-state and 16 to out of state dealers. To obtain a permit, bees must be inspected and the producers must agree to comply with standards designed to maintain healthy colonies. Beekeepers are strongly encouraged to buy only from permitted dealers so as to avoid buying unhealthy or Africanized honey bees. The permit list can be found at:

<http://www.ncagr.gov/plantindustry/Plant/apiary/documents/PermitToSell2016.pdf>.

One of the most devastating and difficult to control bee diseases is American foulbrood (AFB). Out of the estimated 6,417 colonies inspected, 49 were found to have American foulbrood. This demonstrates continued progress in controlling AFB to a level of incidence below 1%. We have maintained the Special Local Need 24(c) registration for the ethylene oxide (EtO) fumigation chamber, as well as a source for the EtO formulation. We are currently providing decontamination services to the beekeepers of North Carolina with the chamber, and it is our belief that it is a valuable tool in controlling AFB as well as other serious pests and diseases.

The mite *Varroa destructor* persists as a major threat to the beekeeping industry in NC and is probably a contributing factor to general poor health or mortality of bee colonies. Several new miticides have been registered; however, the mites have developed resistance to some of these materials in short order and rendered these products ineffective. Currently, the list of registered products for *Varroa* control in North Carolina includes Apistan®, CheckMite+®, Api-Life Var®, Apiguard®, Mite-Away Quick Strips®, Apivar®, oxalic acid (specifically labeled for bees), and HopGuard®. All of the aforementioned products are listed in North Carolina as Section 3 general use pesticides. Although chemical treatment of mites may be necessary, some miticides have been demonstrated to have adverse effects on bees. The growing use of unregistered materials may have adverse effects on honey bee health and may not be efficacious in controlling mites. This and, in some cases, the improper use of antibiotics to control diseases can further complicate useful treatment regimes.

Beekeepers are expressing concerns about pesticides, particularly the neonicotinoids. Bee yards can be registered through the Plant Industry Division. The list of registered yards is sent to Aerial Applicators licensed in North Carolina. For more information about registering, see: <http://www.ncagr.gov/plantindustry/plant/apiary/documents/2015ApiaryRegistrationForm.pdf>.

The NCDA&CS Apiary Inspectors have developed a good working relationship with the Structural Pest and Pesticides Division of the Department. The Pesticide Division responds to reports of acute bee losses and follows up according to the evidence. If a pesticide problem is suspected, timely reporting to an Apiary Inspector or the Pesticide Section is crucial for a valid investigation and resolution. Apiary personnel have collected pollen samples from colonies suspected to be suffering sublethal effects of exposure to neonicotinoids. To date, the samples have contained no detectable levels of these chemicals. The Structural Pest Control and Pesticide Division and the Plant Industry Division are working with U.S. Environmental Protection Agency to develop a Managed Pollinator Protection Plan

Colony Collapse Disorder (CCD) remains a major topic of discussion among beekeepers. The press coverage has highlighted the value of honey bees to a broader audience and raised awareness of their importance. Our inspectors have seen colonies that share many of the symptoms attributed to CCD, but due to the restricted parameters described as symptoms of CCD, this disorder has not yet been documented in North Carolina. This is not to say that it has not occurred here, but we still have not seen evidence specifically attributable to this condition. Most of the colonies we have inspected that show symptoms correlating to CCD reveal evidence of high mite loads or other familiar disorders.

Another threat facing the beekeeping industry of North Carolina is the establishment of Africanized honey bees (AHB) (*Apis mellifera scutellata*) in southern Florida (and finds in Georgia). We are maintaining swarm traps at the ports of Wilmington and Morehead City in order to intercept any bees coming in via ship. We hope to expand this trapping system to some of our land-based points of entry. We continue to engage in an outreach program to North Carolina emergency response personnel to familiarize them with the potential threat of AHB. We are actively collecting samples of bees (particularly those from colonies with overly defensive behavior) to determine their geographic origin and their propensity for this behavior. The NCDA&CS and North Carolina State University are collaborating in conducting this survey. At this time, none of the samples collected have been determined to be of the AHB type. We are striving to have our inspectors and our lab prepared to deal with any AHB incursion or incident. **We encourage beekeepers and the general public to please let us know of any colonies that seem to be displaying any unusual behavior, especially excessive defensiveness. We want to maintain a beekeeping industry in North Carolina that is not threatened by the reputation of this more defensive type of bee.**

We continue to enjoy a good working relationship with our friends in the North Carolina State University Apiculture Research and Extension Program. We have had the opportunity to assist them in some of their projects and would like to express our gratitude for their assistance in many of our projects.

2015 Annual Report

North Carolina Department of Agriculture and Consumer Services, Plant Industry Division

The Apiary Inspection Program is based at the Beneficial Insects Lab, and Glenn Hackney, Research Specialist maintains a lab at that location. Other Apiary staff are based at their homes across the state. During 2015, the inspectors were: Greg Farris, western Piedmont, Nancy Ruppert, Sandhills, Will Hicks, central counties, Adolphus Leonard, Coastal Plain, and Don Hopkins, State Apiarist and Apiary Inspection Supervisor. Jack Hanel, who covered the mountain territory for many years, retired in March, and Lewis Cauble has moved into that role.

Biological Control Programs



CERCERIS FUMIPENNIS AND
PREY



HEMLOCK WOOLLY ADELGID



IMPORTED FIRE ANT AND
PHORID FLY



MILE-A-MINUTE VINE WEEVIL

The mission of the biological control program is to manage exotic pests using ecologically-based methods. We focus on classical biocontrol, reuniting exotic pests with the natural enemies that keep them below damaging levels in their home ranges. Although we are primarily an implementation program, conducting these projects requires research to ascertain the appropriateness of releasing biological control agents or to follow up on agents released. Currently, our projects focus on a variety of exotic insects and weeds, and involve laboratory rearing of insects, field releases of natural enemies, and surveying. Our quarantine facility remains useful to our division as well as to outside cooperators as a secure space for research and monitoring of pests. Personnel working in the program during 2014 included Kathleen Kidd, Biological Control Administrator, Christine Nalepa, Research Specialist, and Rebecca Fergus, Research Specialist for hemlock woolly adelgid rearing. Rebecca Norris, Research Specialist, retired at the end of July, and Nancy Oderkirk has been hired to fill that vacancy.

Implementation of *Cerceris fumipennis* as a Biosurveillance Tool for Pest Buprestidae

The solitary ground nesting wasp *Cerceris fumipennis* continues to be utilized as a biosurveillance tool for the efficient collection of pest buprestid beetles in Canada and in several locations in the eastern and central United States. In 2015 we continued our studies of the wasp in North Carolina by conducting biosurveillance in eleven counties between 26 May and 20 August 2015.

A total of 572 prey beetles were collected from *C. fumipennis* during the 2015 flight season (Table 1); these are in the process of being identified. Emerald ash borer (EAB) was collected by the wasp at one site in Franklin County on 15 June; three EAB were collected from at least two females within the span of about an hour on that date. No further EAB were collected at this site although 12 subsequent visits were made and 214 beetles collected. Despite intensive searches in the area by NCDA personnel, the EAB infested tree could not be located; it was concluded that the EAB collected by *C. fumipennis* most likely emerged from cut firewood in the area. This finding makes North Carolina the second state in the United States to detect EAB using *Cerceris fumipennis*.

Christine Nalepa, Rebecca Norris, Whitney Swink, Kathleen Kidd (NCDA) and Master Gardener Alan Larkins worked on the *Cerceris* project during the 2015 flight season.

Four papers were published in professional journals during 2015:

- Nalepa, C.A., W.G. Swink, J.P. Basham and P. Merten. 2015. Comparison of Buprestidae collected by *Cerceris fumipennis* (Hymenoptera: Crabronidae) with those collected by purple prism traps. *Agricultural and Forest Entomology* 17(4): 445-450. DOI: 10.1111/afe.12114.
- Nalepa, C.A. and W.G. Swink. 2015. Prey carriage varies with prey size in *Cerceris fumipennis* (Hymenoptera: Crabronidae). *Journal of Hymenoptera Research*. 44: 49-55. DOI: 10.3897/JHR.44.5158
- Klingeman, W.E., J.A. Hansen, J.P. Basham, J.B. Oliver, N.N. Youssef, W. Swink, C.A. Nalepa, D.C. Fare and J.K. Moulton. 2015. Seasonal flight activity and distribution of metallic wood boring beetles (Coleoptera: Buprestidae) collected in North Carolina and Tennessee. *Florida Entomologist* 98(2): 579-587. DOI: <http://dx.doi.org/10.1653/024.098.0230>
- Swink, W.G, C.A. Nalepa, and J.P. Basham. 2015. *Agrilus subrobustus* Saunders (Coleoptera: Buprestidae) first detected in North Carolina as prey of the wasp, *Cerceris fumipennis* Say (Hymenoptera: Crabronidae). *Coleopterists Bulletin* 69(2): 274. DOI: <http://dx.doi.org/10.1649/0010-065X-69.2.274>

Table 1 Summary of *Cerceris* nest site visits in 2015

County	Site	Date Visited	# Beetles Collected
Alamance	McCray	12 Jun	16
		18 Jun	12
		29 Jun	0
Buncombe	Vance Elem	15 Jun	15
		16 Jun	26
		18 Jun	2
		19 Jun	16
Franklin	Franklinton Pk	9 Jun	1
		15 Jun	56 (3 EAB)
		22 Jun	76 drops
		25 Jun	41
		2 Jul	45
		7 Jul	11
		8 Jul	1
		16 Jul	21
		22 Jul	4
		28 Jul	8
		4 Aug	4
		6 Aug	3
		13 Aug	0
		20 Aug	0
Franklin	Luddy Park	9 Jun	0
		16 Jun	51
		29 Jun	12
		4 Aug	0
Gaston	Aaron Moss	23 Jun	22
		1 Jul	0
Guilford	Lebanon Baptist	17 Jun	2
Mecklenburg	Newell	15 Jun	0
Pender	Hoover Rd.	1 Jun	0

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North Carolina Department of Agriculture and Consumer Services, Plant Industry Division

Surry	Meadowview MS	18 Jun	6
		21 Jun	0
Wake	Jaycee Park	11 Jun	0
		18 Jun	0
Wake	Lake Lynn	26 May	0
		29 May	0
		1 Jun	0
		6 Jun	0
		11 Jun	13
		13 Jun	45
		4 Aug	0
Wayne	Faith Christian	26 May	0
		29 May	0
		6 Jun	6
		8 Jun	31
		10 Jun	15
		5 Aug	0
Wayne	Wayne Comm Coll	26 May	0
		29 May	0
		6 Jun	0
		10 Jun	7
Yancey	Mtn Heritage HS	17 Jun	0
		25 Jun	3
		16 Jul	1
11 Counties	14 Sites	54 Site Visits	572 Beetles Collected

Hemlock Woolly Adelgid Predator Rearing

The primary objective for this project was for NCDA&CS to operate a large-scale central rearing facility to provide biological control agents for the management of hemlock woolly adelgid (HWA). *Sasajiscymnus tsugae* (St), native to Japan has been in mass production at the lab since December 2002. In 2012, our colony of beetles that originated from the original NJ colony and a 2008 collection from Japan crashed. Replacement beetles were supplied by Patrick Parkman of the Lindsay Young Beneficial Insect Lab of the University of Tennessee.

The hemlock woolly adelgid occurs over multiple states, and is now distributed throughout the native range of the eastern and Carolina hemlock species. Hemlock is widespread in National and State Forests and Parks, and the loss of the hemlock is causing major changes to the ecology of those areas. In addition to a loss of a unique ecosystem, dead and dying trees are a safety hazard in recreation areas, as well as aesthetically unattractive. Although some chemical control measures are recommended for specimen trees, control with insecticides is difficult in any setting and impractical to impossible in forest settings.



Figure 2 Dead hemlock trees in Linville Gorge, NC 2012.

Because the hemlock stands and HWA infestations are scattered over a wide area, rearing and releasing large numbers of beetles in carefully-selected areas is preferred to relying on natural spread. A large-scale central rearing program supported by the USDA-Forest Service can provide these agents and coordinate releases for the southeastern region.

The predator beetles are well synchronized with the lifecycle of the adelgid. The adelgid becomes dormant for the summer as early stage settled nymphs, and in response, the beetles also enter a period of reproductive dormancy. At the end of aestivation period, when the adelgid began to mature and prepare for oviposition, hemlock boughs were stored in spring-like conditions to stimulate oviposition.

For mass production of the colony, mating groups of 15 beetles (10 female, 5 male) were placed in 3.8 l jars supplied with a bouquet of hemlock twigs and three strips of gauze. Eggs (on the twigs and gauze) were removed weekly and put in rearing cages supplied with infested hemlock. Infested twigs and water were supplied and after 4 weeks, adult beetles collected and moved into storage cages. The scarcity of healthy HWA infested hemlock made it imperative that only necessary amounts were used in oviposition jars. Oviposition jars for the 2014-2015 season were set up beginning 17 November 2014. Oviposition concluded 18 May 2015. A small colony was maintained during the summer until new mating groups were assembled in the fall.

Sasajiscymnus tsugae beetles regularly oviposited high numbers of eggs, but adequate material for rearing was scarce. Our contact with the USDA Forest Service was no longer able to obtain suitable material. We were able to collect from an abandoned nursery in Ashe County, until extremely cold winter weather in January killed most of the adelgids (~80%). Another lightly infested site was found in Burke Co., and regular collections from this location provided material.

During the production season, an estimated 29,000 eggs were oviposited and 6000 *S. tsugae* beetles were produced. Personnel assigned to the project during 2014-15 rearing season were Rebecca Fergus, Research Specialist at $\frac{3}{4}$ time. We thank Amanda Cook, Plant Pest Specialists for assistance with locating and collecting infested hemlock.

Status of the field release and monitoring of phorid flies *Pseudacteon* spp for the imported fire ant

Since the discovery of the imported fire ant (IFA) in North Carolina in 1953 it has spread to approximately 90 out of 100 counties (NCDA&CS, 2013). In an effort to slow the spread and decrease population size, biological control measures have been undertaken across the state. A complex of flies in the family Phoridae is known to attack *Solenopsis* spp. ants in their native South America (Porter, 1998). The phorid fly, sometimes referred to as the decapitating fly, lays individual eggs into worker ants while they forage or defend their mounds. After hatching, the fly larva moves into the ant's head to feed, and consumes soft tissue, eventually resulting in the ant's head falling off (Porter et al, 1995). When phorid flies are present, ants decrease foraging to avoid the flies. Less foraging activity results in fewer ants and smaller and/or fewer mounds, allowing native ants and other insects to better compete for resources (Mehdiabadi et al, 2004).

Releases. Since 2000, 4 species of phorid flies *Pseudacteon tricuspis*, *P. curvatus*, *P. obtusus* and *P. cultellatus* have been released in 11 counties of North Carolina (Table 2). The species of phorid flies selected for release at each locality was based on the most prevalent type of ant colonies present: monogyne colonies with one queen or polygyne colonies with multiple queens. *P. tricuspis* and *P. obtusus* flies typically attack larger workers usually found in the monogyne colonies whereas *P. curvatus* and *P. cultellatus* shows a preference for smaller workers common to polygyne colonies (Morrison et al. 1997). In 2015, fire ants were collected from a pasture in Anson County 28 August and 8 September and sent to the USDA ARS-CMAVE phorid fly rearing lab in Gainesville, Florida to be parasitized by the phorid flies *P. obtusus* and *P. cultellatus*. After exposure to the phorid fly, the ants were shipped back to North Carolina and released into the mounds from which they were taken. Fire ant populations were low due to very dry conditions at the time of collection.

Surveys. A modified version of sticky traps developed by Puckett et al. (2007) was used to monitor for *P. obtusus* and *P. cultellatus* in Johnston, Wake and Franklin County. The traps consist of plastic tri-stands (used to keep the pizza from sticking to the delivery box) glued to 60 x 15 mm plastic petri dishes. The pizza tri-stand and sides of the petri dishes were coated with Fluon™ to prevent the fire ants from escaping and climbing the tri-stand. Inverted tri-stands were anchored to the single tri-stand with Velcro, and the legs of the inverted stands were coated with Tanglefoot® (Figure 3). Traps were placed at or near the fire ant mounds and baited with live ants and bits of Vienna sausages to attract phorids. Flies became ensnared in the Tanglefoot® when they alighted to rest on the upright legs.



Figure 3 Sticky trap for capturing phorid flies.

Surveys were conducted in late September and October. Traps were retrieved one to two days after placement in the field. Flies collected were identified using ovipositor morphology.

Results: Field conditions were dry, which limited ant activity. After October rains, fire ant populations increased dramatically, but made trapping impossible. The only phorid flies detected this year on the sticky traps were *P. curvatus*, and they are persisting in all counties monitored. During collection of ants in Anson County, *P. curvatus* could easily be observed attacking the ants. Trapping will continue in the fall of 2016 as conditions allow.

Table 2 Site information for Pseudacteon releases

County	Year	Species	Number (estimated)
Beaufort	2000	<i>Pseudacteon tricuspid</i>	3000
Duplin	2002	<i>Pseudacteon tricuspid</i>	2973
Robeson	2003	<i>Pseudacteon tricuspid</i>	3849
Wayne	2004	<i>Pseudacteon tricuspid</i>	5000
	2008	<i>Pseudacteon curvatus</i>	12,000
Wake	2005	<i>Pseudacteon curvatus</i>	13,708
	2013	<i>Pseudacteon cultellatus</i>	6096
	2013	<i>Pseudacteon obtusus</i>	1404
Pitt	2006	<i>Pseudacteon tricuspid</i>	3639
	2010	<i>Pseudacteon curvatus</i>	12,000
	2010	<i>Pseudacteon obtusus</i>	1100
Scotland	2007	<i>Pseudacteon tricuspid</i>	5206
		<i>Pseudacteon curvatus</i>	13,008
Gaston	2009	<i>Pseudacteon curvatus</i>	11,000
Randolph	2011	<i>Pseudacteon curvatus</i>	4914
		<i>Pseudacteon obtusus</i>	2984
Franklin	2012	<i>Pseudacteon curvatus</i>	9312
		<i>Pseudacteon obtusus</i>	2417
Johnston	2014	<i>Pseudacteon obtusus</i>	5077
		<i>Pseudacteon cultellatus</i>	4128
Anson	2015	<i>Pseudacteon obtusus</i>	1364
		<i>Pseudacteon cultellatus</i>	9408

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Mile-A-Minute Vine Biological Control

Native to Asia, mile-a-minute vine (MAM), *Persicaria perfoliata* (L.) H.Gross, is a fast-growing member of the Polygonaceae family. Hough-Goldstein et al. (2008) provided an overview of the biology and biological control of *P. perfoliata*. This invader has been present in the USA since the mid-1930s. A sun-loving annual vine, it is frequently found in riparian areas and can quickly grow over other vegetation (Figure 4). MAM is easily identified by its key characteristics: triangular leaves, spines on the reddish-colored stems and leaves, and a modified leaf (ochrea) that surrounds each node of the vine. Small white flowers develop into berry-like fruit that turns a bright metallic blue. Seeds can remain viable in the soil for up to 6 years and spread via waterways, birds, and mammals.



Figure 4 Mile-a-Minute vine overgrowing other vegetation.
Adult weevil damage can be seen on the foliage. Alleghany County weevil dispersal site, 2015.

Rapid growth, prolific flowering, long-lived seeds, a preference for riparian areas and ability to overtop most native plants make chemical control of MAM difficult. Biological control is often the most practical strategy for dealing with this weed.

The USDA Forest Service and the University of Delaware initiated surveys for natural enemies in Asia, and *Rhinoncomimus latipes* Korotyaev was selected as the most promising species from China and Japan. The weevil was tested for feeding on non-target plants, and none were found. This weevil has been released in numerous states in the eastern United States, and is currently

being reared at the Philip Alampi Beneficial Insect Lab (PABIL) of the New Jersey Department of Agriculture. Adult weevils feed on the foliage of the plant, but larvae tunnel within stems.

Surveys. Delimiting surveys have been conducted to determine the extent of MAM infestations after populations were initially reported. These were “windshield” surveys, looking for populations along the roadsides, or walking/wading to map infestations along stream banks. “Float” surveys were conducted along the Mayo and Dan Rivers in Rockingham County. After weevil releases, sites have been visited at least once annually, and delimiting surveys for weevil spread were conducted in Gates, Pasquotank, and Alleghany Counties in 2015. When a population of MAM was found, plants were searched visually or by tapping to dislodge insects until weevils were found. If no weevils were found, the search ended after 15 minutes.

Results and Establishment. A summary of weevil releases is shown in Table 3. Weevils have been released in multiple years at sites with dense populations, resulting in 25 unique sites in 6 counties over a period of 5 years.

Mile-a-minute vine is widely distributed in North Carolina, from the mountains to the coast (Figure 5). Infestations vary in their density and size. Alleghany County has multiple streamside and roadside infestations that range from small patches to dense thickets. Weevils have persisted at all release sites for one or more years after release, and dispersal of almost 5km from release sites has been documented (Figure 6).

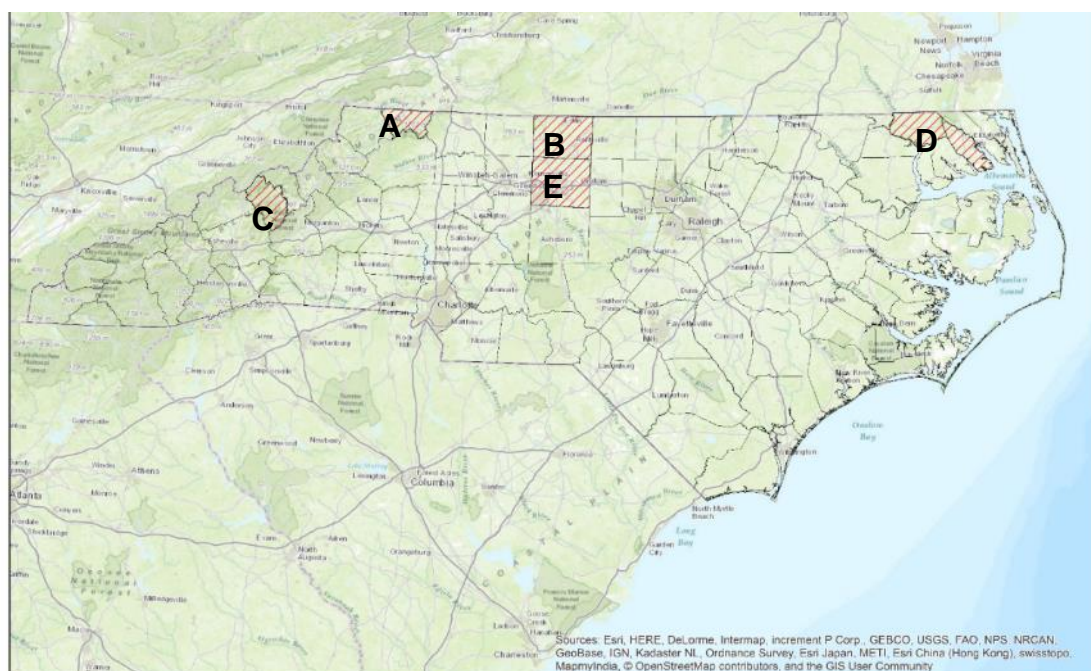


Figure 5. Mile-a-Minute infestations in North Carolina.

Counties with hatch markings are infested. Letters correspond with the order in which county infestations were reported. A = Alleghany, B = Rockingham, C = Yancey, D = Pasquotank and Gates, E = Guilford.

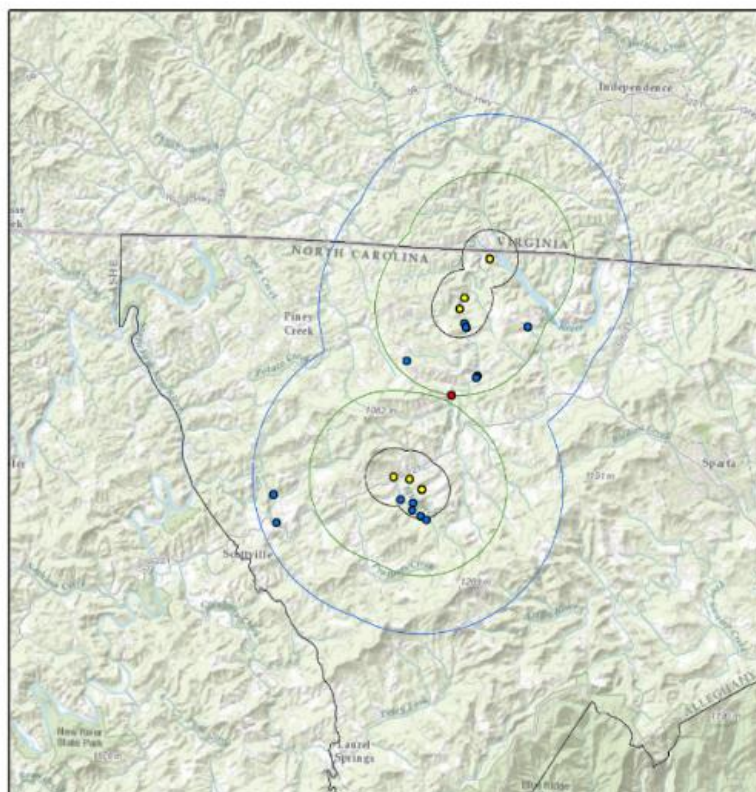


Figure 6 Alleghany County weevil releases and dispersal.

Yellow = weevil release site, *blue* = weevil recovery, *red* = MAM infestation, no weevils recovered. Buffer zones represent 1 (black), 3 (green), or 5km (blue) from release sites.

The Yancey County infestation was small and appeared limited in area. Weevils are considered established there after overwintering three years, and in 2014 they were found up to 3km away from the release site. In 2015, no plants were found at these locations. Weevils would not account for the total disappearance of the plants, but other factors including late frost or early season mechanical control may explain the absence of MAM.

In the timberland of the northeastern counties, populations line the drainage ditches that cross fields as well as covering harvested fields. Weevils were recovered at and near 2014 release sites.

Rockingham County has high populations along the Mayo and Dan Rivers, popular recreational rivers crossed by multiple power lines. The rights of way under these provide easily invaded habitat, and seeds can easily be distributed by water and wildlife.

Table 3 Releases of *Rhinoncomimus latipes* in North Carolina by year.

Year	County	# Weevils	# Locations
2011	Alleghany	2200	6
	Yancey	200	1
2012	Alleghany	4800	6
2013	Alleghany	2500	3
2014	Alleghany	300	1
	Guilford	200	1
	Pasquotank	4000	5
	Rockingham	500	1
2015	Gates	3000	6
	Rockingham	1350	3
Totals	6	19,050	25 (Unique)

The Guilford infestation appears to be limited to one site at this time, but it is under a powerline right-of-way and in the path of road construction. Weevils have persisted for one year at this site, and it warrants careful monitoring as soil and other material is moved from the site.

Conclusions. Mile-a-minute vine, *Persicaria perfoliata*, is found in six or more counties in North Carolina, and in habitats ranging from mountain valleys to the coastal plain. The biological control agent *Rhinoncomimus latipes* appears to be well adapted to a variety of habitats in the state, and have overwintered one or more years. They are becoming established and dispersing from release sites. These results are similar to those found in areas to the north, where weevils dispersed at rates of 125m to 3.5km per year (Hough-Goldstein et al. 2009). As weevils multiply and continue to disperse, we expect to see increased foliar damage, decreased seed production, and reduced stands.

A poster “Biological Control of Mile-a-Minute Vine in North Carolina Using the Weevil *Rhinoncomimus latipes* Korotyaev,” based on this work was presented at the Annual Meeting of the Entomological Society of America, Minneapolis, MN.

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Cooperative Agriculture Pest Survey (CAPS) Program

The CAPS program is a national, early warning pest detection network, funded through a cooperative agreement with USDA-APHIS-PPQ for domestic surveillance of exotic plant pests. Such pests hold economic, agricultural and/or environmental importance to North Carolina (NC) and the U.S. and typically include plant pests that are not known to occur domestically. These surveys help safeguard our nation's agriculture and natural resources through early detection, especially by those pests that pass through front-line inspections at our ports of entry. Surveys also concentrate on pests of export significance which are of concern to our trading partners. The CAPS program follows guidelines to ensure that data, on a continuing basis, is scientifically valid, current and reliable. The state CAPS advisory committee helps drive and focus surveys for each state. Its core members include the State Plant Health Director (SPHD), State Plant Regulatory Official (SPRO), Pest Survey Specialist (PSS) and the State Survey Coordinator (SSC). Other members may be invited to provide guidance in their area of expertise. National and/or State level surveys concentrate on three main areas of importance; entomological, pathological or exotic weed species. All data collected from these surveys are entered into the National Agricultural Pest Information System (NAPIS) before December 1st for inclusion into the Nation Plant Board's annual report.

Executive Summary

The North Carolina CAPS program completed 6 independent surveys throughout the state during the 2015 season. Such surveys included; exotic wood borer and bark beetle, oak commodity, grape commodity, Asian defoliators, phytophthoras and solanaceous commodity. A total of twenty-seven different exotic plant pests were surveyed. The survey season began in March and ended in October. The timing of each survey was dependent on the individual pest. **There were no positive detections for any of the targeted plant pests.** Surveys were completed following the 2015 CAPS guidelines.

The NC CAPS advisory committee conducted its annual meeting on July 1st, 2015. The meeting focused on planning survey objectives for the upcoming 2016 season. Looking ahead, the team agreed to begin a couple new surveys next year; mollusk and forest pests. Survey priorities for 2016 were determined and survey plans were made to minimize overlap across survey programs. New survey proposals were submitted through CAPS and Farm Bill outlining the advisory committee's suggestions.

Exotic Wood Borer and Bark Beetle

Trapping for six-toothed bark beetle (*Ips sexdentatus*), European spruce bark beetle (*Ips typographus*) and pine shoot beetle (*Tomicus piniperda*) was accomplished throughout the state at thirty locations (Figure 7) and in more than twenty counties. Multi-funnel traps were used and visited bi-weekly from March through May with more than 8,800 bark beetles identified (Table 4). Purple prism traps and visual observations were used to survey goldspotted oak borer (*Agrilus auroguttatus*) and Asian longhorned beetle (*Anoplophora glabripennis*) respectively. The addition of a part time taxonomic entomologist to our team enabled us to identify all bark beetles caught during the course of this survey. **No target species were observed or determined to be positive in any of the screened samples for this survey.**

Geocache locations were used as a form of outreach (Figure 7). A partnership between the North Carolina Division of Parks and Recreation, NCDA&CS and the Geocaching community was established. This was the first season doing this outreach with a lot of positive feedback from those who found the caches. In all, six sites were selected. Educational items and riddles were used to pass along general information about the pests of concern in our state.

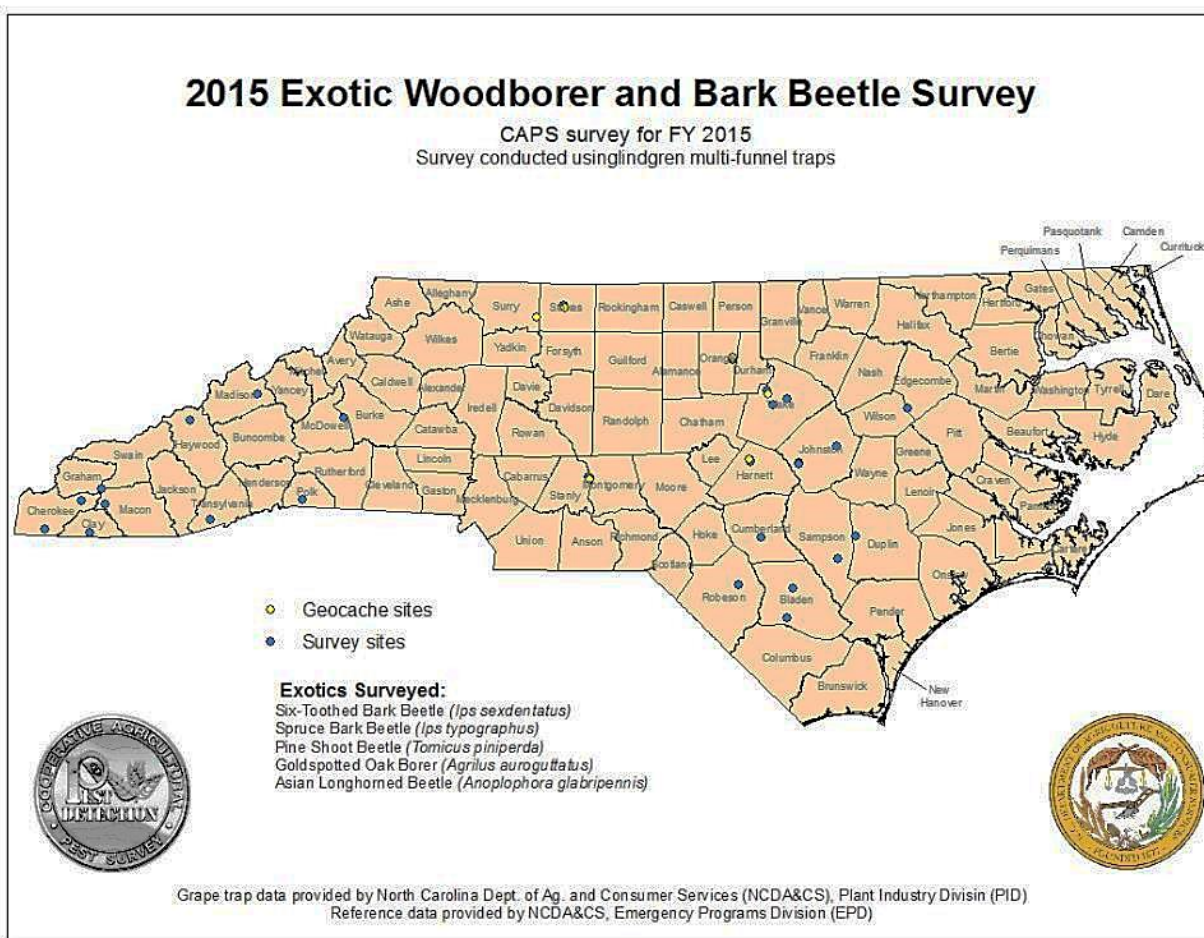


Figure 7 Exotic woodborer and bark beetle survey and geocache sites, 2015.

Table 4 List of species caught in exotic woodborer and bark beetle traps in 2015.
 The number of traps containing each species and the total number caught are detailed.

Species	# Traps	# Beetles	Species	# Traps	# Beetles
<i>Ambrosiodmus obliquus</i>	34	137	<i>Ips avulsus</i>	4	7
<i>Ambrosiodmus sp.</i>	1	1	<i>Ips calligraphus</i>	10	16
<i>Ambrosiodmus spp.</i>	1	9	<i>Ips grandicollis</i>	18	71
<i>Ambrosiodmus tachygraphus</i>	1	1	<i>Monarthrum mali</i>	7	11
<i>Ambrosiophilus atratus</i>	32	80	<i>Orthotomicus caelatus</i>	3	5
<i>Carphoborus bicornis</i>	2	3	<i>Phloeotribus liminaris</i>	1	1
<i>Carphoborus bicornus</i>	1	1	<i>Pityogenes plagiatus</i>	3	5
<i>Cnestus mutilatus</i>	48	616	<i>Pityophthorus sp.</i>	7	12
<i>Corthylus punctatissimus</i>	8	12	<i>Pityophthorus spp.</i>	3	24
<i>Cyclorhipidion bodoanum</i>	2	2	<i>Platypus flavicornis</i>	8	9
<i>Dendroctonus terebrans</i>	14	55	<i>Trypodendron lineatum</i>	1	1
<i>Dendroctonus valens</i>	3	5	<i>Xyleborinus saxeseni</i>	53	403
<i>Dryocoetes sp.</i>	1	1	<i>Xyleborus affinis</i>	1	4
<i>Euwallacea validus</i>	29	120	<i>Xyleborus celsus</i>	1	1
<i>Gnathotrichus materiarius</i>	16	17	<i>Xyleborus ferrugineus</i>	27	89
<i>Hylastes porculus</i>	14	23	<i>Xyleborus pubescens/intrusus</i>	38	154
<i>Hylastes salebrosus</i>	10	27	<i>Xyleborus sp.</i>	25	54
<i>Hylastes tenuis</i>	25	65	<i>Xyleborus spp.</i>	1	3
<i>Hylocurus rudis</i>	4	6	<i>Xylosandrus crassiusculus</i>	105	6318
<i>Hypothenemus crudiae</i>	2	4	<i>Xylosandrus germanus</i>	84	434
<i>Hypothenemus sp.</i>	15	23	<i>Xyloterinus politus</i>	5	5
<i>Hypothenemus spp.</i>	1	4	Grand Totals	669	8839

Oak Commodity Survey

North Carolina completed the 2015 oak commodity survey by setting traps for the following exotics; oak splendor beetle (*Agrilus biguttatus*), variegated golden tortrix moth (*Archips xylosteanus*), false codling moth (*Thaumatotibia leucotreta*), oak processionary moth (*Thaumetopoea processionea*), green oak tortrix moth (*Tortrix viridana*) and oak ambrosia beetle (*Platypus quercivorus*). Trapping for this survey began in May and ended in September. Thirty locations spread over sixteen counties were observed for the aforementioned pests (Figure 8). Bi-weekly visits for collection of oak ambrosia beetle trap catch and monthly visits were conducted to all other traps for lure replacement, sticky card collection or trap replacement. This survey utilized several trap types including the purple prism, wing, lindgren funnel and delta traps and was conducted in private nurseries, state parks and public and private land. Samples were screened for the presence of all target pests by the SSC with help from the division taxonomic entomologist.

Combined, this group of invasive pests represents a significant threat to the economic and agricultural well-being of North Carolina. Together, they have an impressive host range and include nursery stock, cut flowers, stone fruits (peach, plum, cherry, etc.), pome fruits (apple and pear), grape, elm, ash, maple, oak, blackberry, cotton, honeysuckle, lilac, rose, strawberry, blueberry, rhododendron, corn, okra, pepper, sorghum and other host species. **No target species were observed or determined to be positive in any of the screened samples for this survey.**

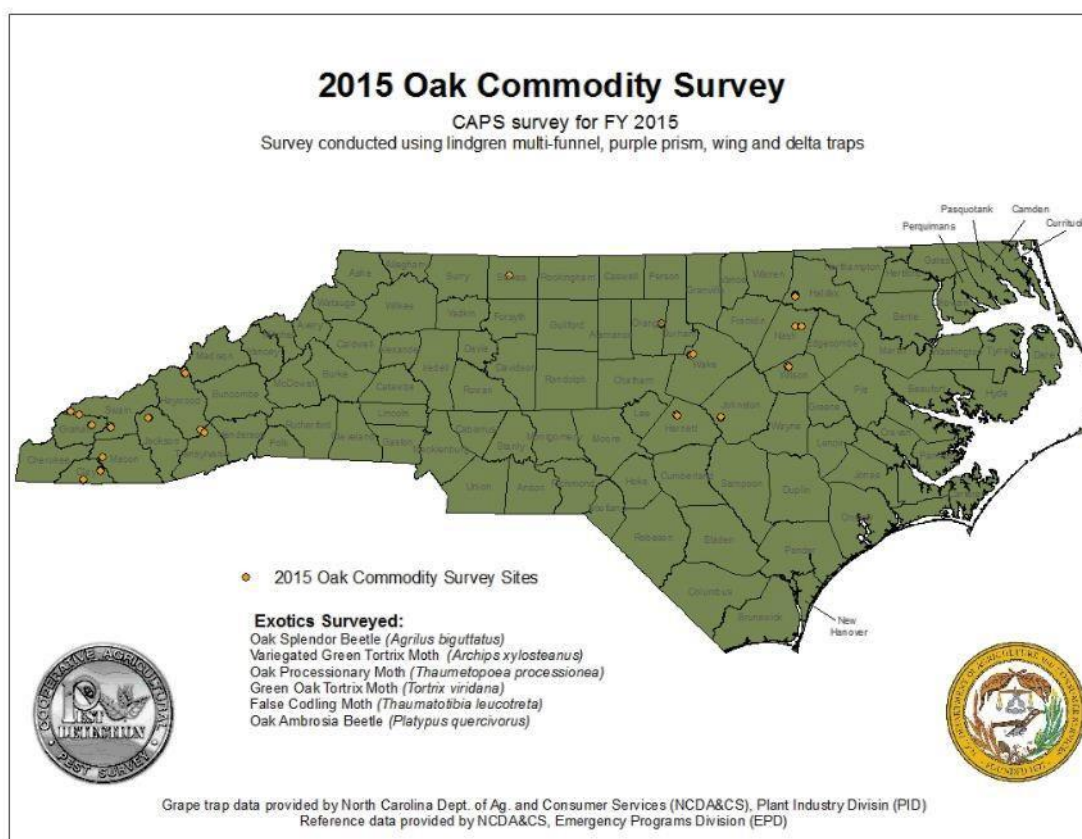


Figure 8 The 2015 oak commodity survey locations for North Carolina.

Asian Defoliators

Six exotic plant pests under the Asian defoliators banner were surveyed for; Asian Gypsy Moth (*Lymantria dispar asiatica*), Rosy Moth (*L. Mathura*), Nun Moth (*L. monacha*), Pine Tree Lappet (*Dendrolimus pini*), Masson Pine Moth (*D. punctatus*) and Siberian Silk Moth (*D. sibiricus*). An introduction of any of these exotics under this banner would have serious implications for North Carolina forests. Host trees for these pests are considered economically important and include oak, pine, ash, elm, maple and walnut. Special emphasis was given to deep water ports of entry and military installations.

Traps were placed in June and pulled in September with monthly site visits to replace sticky cards and/or lures. It was previously determined that multiple survey locations exist on large military installations, and may include a combination of several forms of conveyance including deep water ports with rail yards, or airstrips. A total of 15 trapping locations were placed across the state (Figure 9). Samples were collected at the servicing of each trap and screened for the presence of target pests. **No target species were observed or determined to be positive in any of the screened samples for this survey.**

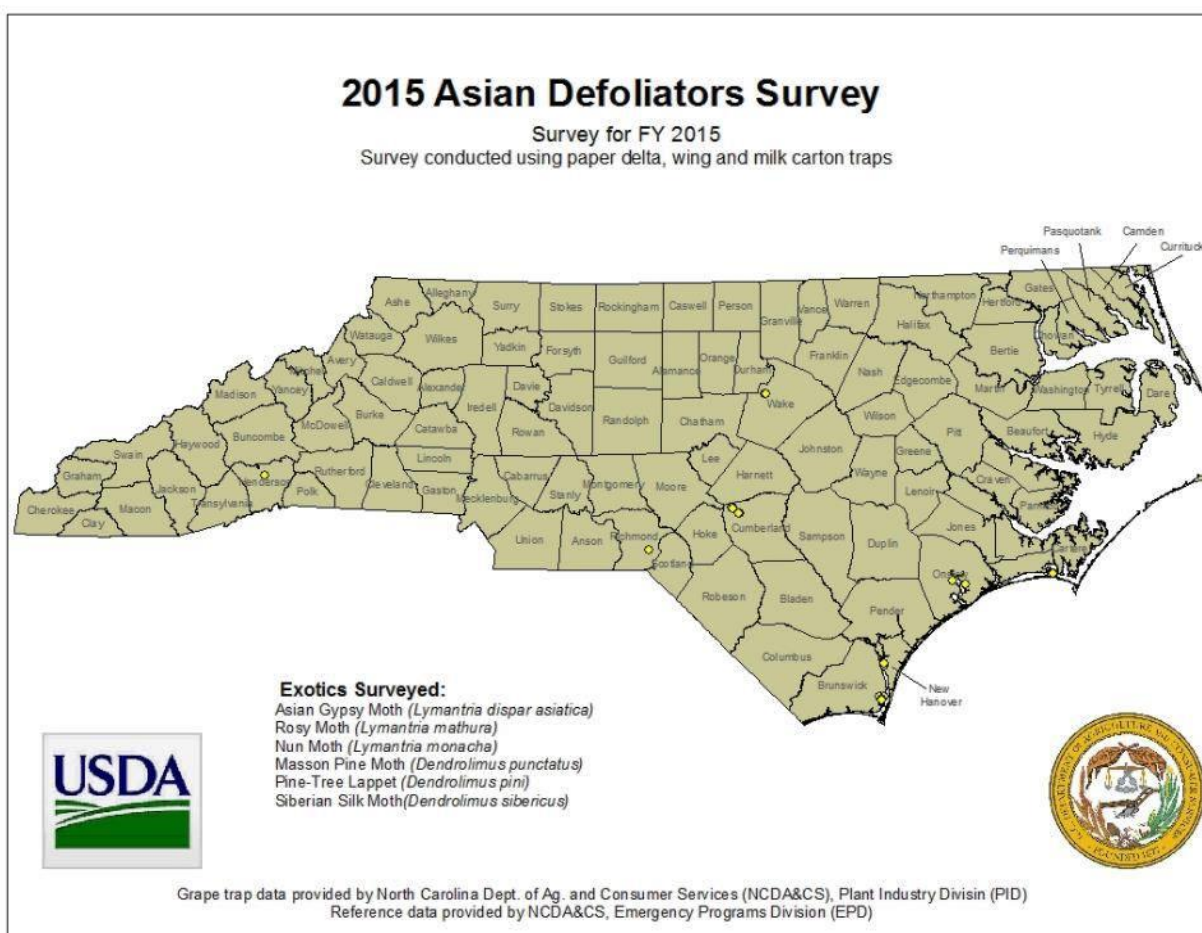


Figure 9 2015 Asian defoliators survey sites for North Carolina.

Grape Commodity

Several exotic grape (*Vitis vinifera* and *V. rotundifolia*) pests were surveyed in production areas. They include; Summer Fruit Tortrix Moth (*Adoxophyes orana*), Light Brown Apple Moth (*Epiphyas postvittana*), European Grapevine Moth (*Lobesia botrana*), Egyptian Cottonworm (*Spodoptera littoralis*) and Cotton Cutworm (*Spodoptera litura*). The survey was completed using Jackson, delta and bucket traps that were placed in July and pulled in September. Trapping was spread throughout the state with twelve locations (Figure 10). Samples were collected at the servicing of each trap and screened for the presence of target pests. **No target species were observed or determined to be positive in any of the screened samples for this survey.**

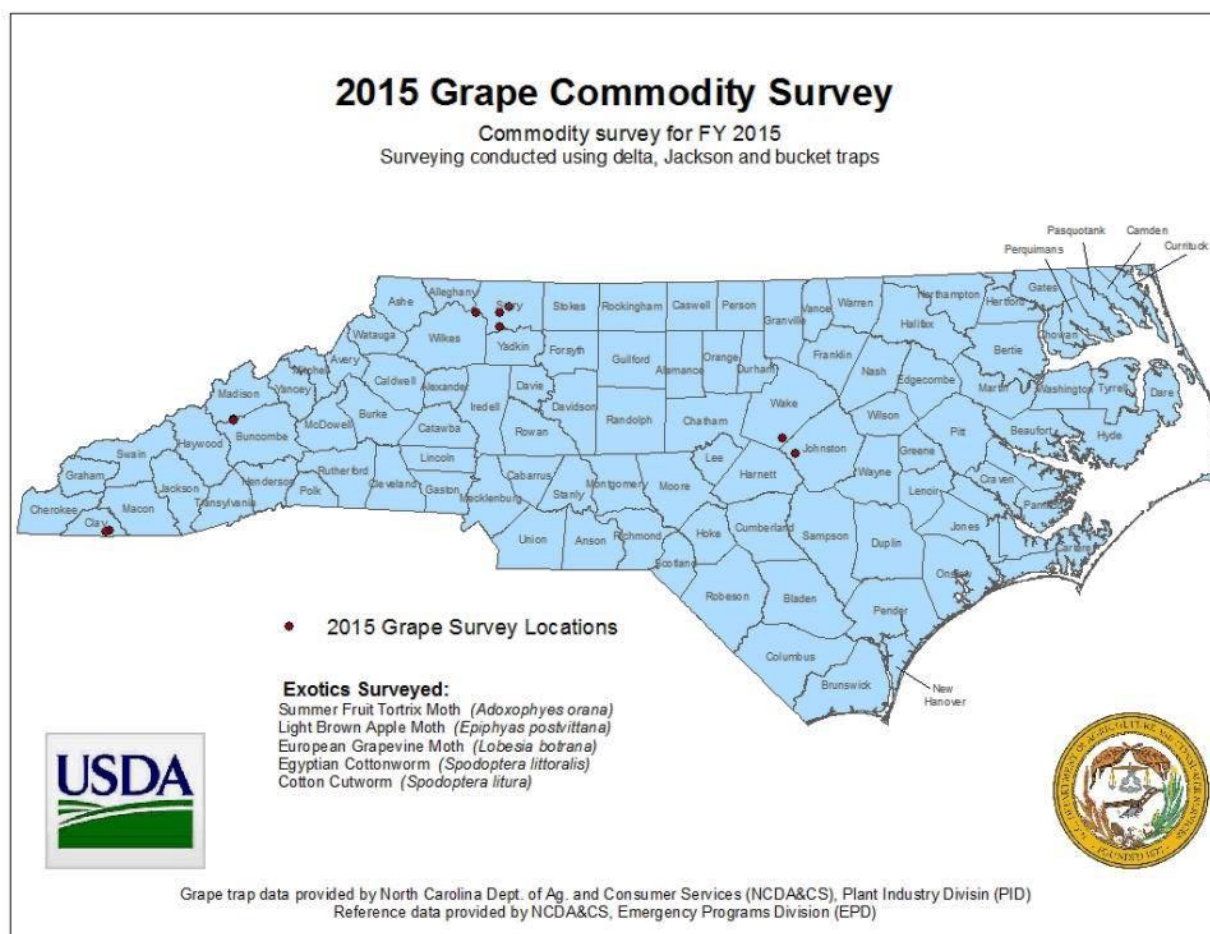


Figure 10 2015 grape commodity survey locations for North Carolina.

Solanaceous Commodity

Three exotic plant pests of the solanaceous commodity were surveyed; tomato leaf miner (*Tuta absoluta*), old world bollworm (*Helicoverpa armigera*) and golden twin spot moth (*Chrysodeixis chalcites*). All are regarded as being highly destructive pests of solanaceous crops and pose a significant threat to North Carolina agriculture.

Helicoverpa armigera, the old world bollworm, is found in parts of Africa, Asia, Europe, Middle East and Oceania. In early 2013, in the state of Mato Grosso, Brazil, both larvae and moths were collected from infested *Bacillus thuringiensis* (Bt) cotton fields, and were later confirmed through molecular characterization as being *H. armigera*. Old world bollworm was recently detected in Puerto Rico in September of 2014 and most recently in Florida in 2015. This pest is known for quickly developing levels of resistance to commonly used insecticides, including resistance to transgenic crops using Bt. Capable of long distance migration, it may adapt to environmental conditions if it becomes too warm or dry. Economically, it is one of the more costly pests and reports of serious losses are common. Early identification of this pest will limit spread to the natural environment and aid in eradication.

North Carolina has host material and climate to support these exotics. We surveyed host sites that included commercial tomato and tobacco production fields. Trap set occurred in June and ended in September when traps were pulled. In all, forty-five sites spread across 18 counties were chosen for this survey (Figure 11). Samples were collected at the servicing of each trap and screened for the presence of the target pests by the SSC with assistance from a taxonomic expert hired to help with this project. We also received taxonomic help from North Carolina State University's Plant Disease and Insect Clinic (PDIC) on how to perform dissections and distinguish native species from exotics. **No target species were observed or determined to be positive in any of the screened samples for this survey.**

In August, an extension to this survey was granted to identify putative collections of *Helicoverpa armigera*. Dissections were completed on more than 300 suspect individuals with no positive determinations (Table 5). In addition, three suspect specimens of golden twin spot moth were dissected and determined to be the soybean looper, whose appearance is identical to the target (Figure 12).

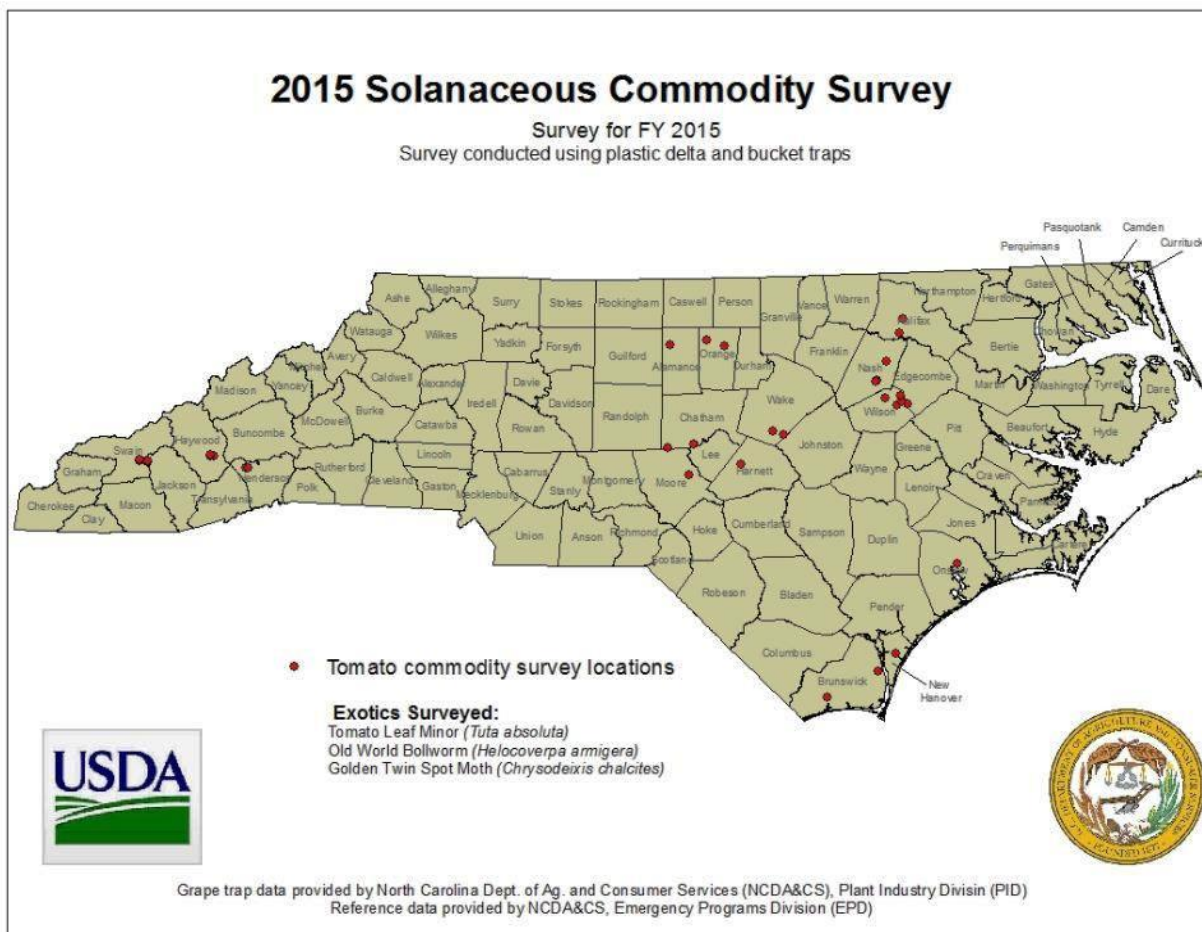


Figure 11 2015 Solanaceous survey locations for North Carolina.

Table 5 Total number of dissections for old world bollworm (*Helicoverpa armigera*) from suspect samples taken during 2015 solanaceous survey. Six of the fifteen counties produced suspect specimens.

County	No. Dissections
Wilson	116
Haywood	12
Henderson	51
Nash	71
Halifax	53
Swain	3
	306

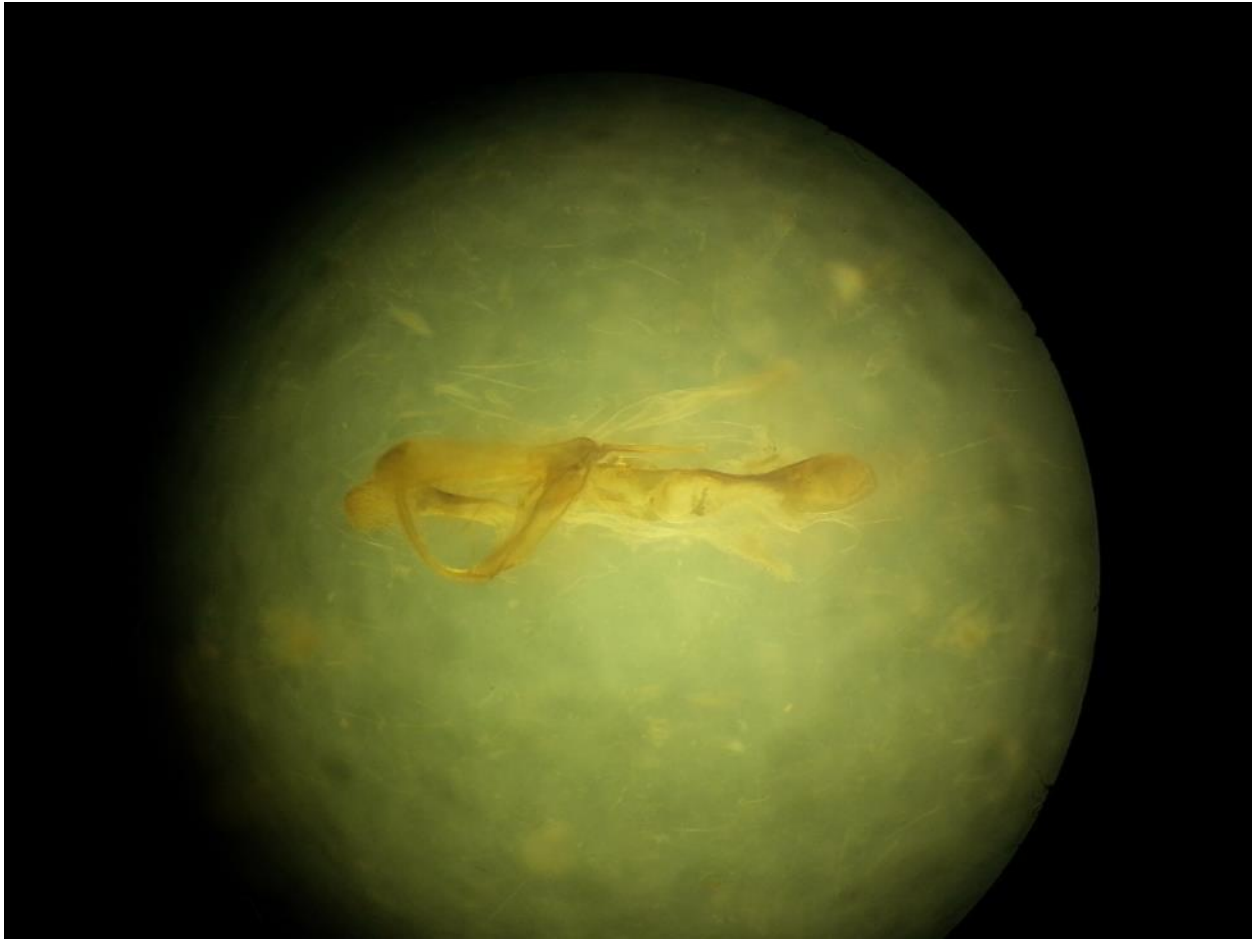


Figure 12 Abdomen dissection of a putative *Chrysodeixis chalcites*.
Sample was taken during the 2015 solanaceous survey.

Phytophthora

North Carolina is currently engaged in a state specific *Phytophthora ramorum* and *P. kernoviae* survey. Since both pathogens share common hosts and affect stem and leaf tissue, a survey was developed to include both for improved efficiency. To date, more than 88,000 host plants have been surveyed across 32 different locations that include nurseries and stream side vegetation surveys. Of this total, thirty-five samples were submitted for testing of which seven were phytophthora positive and sent to Kansas State University-Manhattan Diagnostic Laboratory for further diagnostics. **All positive phytophthora samples tested negative for our targets.** This survey is still ongoing and final results will be forthcoming.

Entomological Programs

The following report describes the most important activities and accomplishment of NCDA&CS Plant Industry Division, Entomological Programs during 2015. It encompasses surveys done for different entomological programs and permits associated with the movement of live insects into the state for commercial, educational and research purposes.

Sweet Potato Weevil Program

North Carolina's sweet potato production and production areas continue to increase as demand for sweet potatoes increases in national and international markets. In 2015, a record 98,078 acres of sweet potatoes were reported in NC, an increase of 36% compared to the total area reported in 2014 (from Farm Service Agency crop report data). The success of the sweet potato industry in North Carolina is attributed to several factors including an efficient marketing strategy, strong research programs at state universities aimed at developing new and better varieties and intensive regulatory programs intended to keep the sweet potato weevil (SPW) (*Cylas formicarius*), the most important pest of sweet potatoes in the world, out of the production areas in North Carolina. The SPW is a pest of regulatory concern that can significantly affect the North Carolina sweet potato industry by 1) reducing yields in affected fields, 2) damaging the quality of infested sweet potatoes, 3) increasing the production cost for farmers and 4) imposing restrictions on the movement of sweet potatoes from affected to non-affected areas in North Carolina and outside of the state.

Our mission at the NCDA&CS Plant Industry Division is to implement effective plant pest programs to reduce the risk of accidental introductions of SPWs in the North Carolina sweet potato production areas, and to mitigate and eradicate any introduced weevil populations in the state to protect the sweet potato industry. Early detection and rapid response (EDRR) of weevil detections is instrumental for a successful eradication program. Our most important tool for EDRR is survey. Every year, surveys are conducted throughout the state using traps baited with lures containing a female-produced pheromone that attracts male sweet potato weevils. These traps are deployed in production fields, regulatory sites, including but not limited to storage, processing and packing facilities, micro propagation greenhouses and/or any other sites where regulated articles for sweet potato weevil are found. Traps are also deployed in the NC sweet potato weevil quarantine area in New Hanover and Brunswick counties to monitor potential movement of sweet potato weevils into the production areas and, to conduct research.

On March 19 2015, the NCDA&CS Plant Industry Division conducted a tabletop exercise to review our procedures and protocols for responding to a SPW detection in our production areas. In addition to Plant Industry Division staff, representatives from the NCDA&CS Emergency Programs Division, the North Carolina Cooperative Extension Service and the North Carolina Sweet Potato Commission participated in the exercise. The result of the planning exercise was an Early Detection and Rapid Response Plan that will serve as guidance for any future SPW detections in North Carolina sweet potato production areas.

Field Surveys

Field surveys were conducted from early August to mid-September 2015 in 47 counties primarily in Eastern North Carolina. 13,331 traps were set in 98,073 reported acres (Table 6). Trap set was done following the established guidelines and protocols developed by the Southern Plant Board (SPB) in 1995. Briefly, two traps were placed for the first 10 acres and 1 additional trap for each additional 10 acres with a minimum of 2 traps per field. Conventional green boll weevil traps were used because of their low cost (Figure 13-A). Traps were deployed at an average density of one trap for every 7.36 acres and left in the field for an average of 23.62 days. These values are in accordance with the established SPB sweet potato weevil survey guidelines. Custom made georeferenced pdf (GeoPdf) maps were used in mobile devices (iPad minis) to navigate and locate sweet potato fields and to collect data including time and date of trap set, field type (reported, unreported and absent) and coordinates (latitude and longitude) for each trap set. Data collected during the trap pull process include the trap condition (lost, damage, good) and the number of weevils found. **No weevils were found in field surveys during this period in 2015.**

Table 6 Summary of the 2015 sweet potato weevil field surveys in NC.

County	Reported Fields	Reported Acres	Acres Per trap	Traps set (n)	Mean No. of days in the field \pm s.e
Beaufort	14	169.06	8.90	19	21.32 \pm 0.48
Bertie	55	634.42	8.13	78	21.00 \pm 0.00
Bladen	66	774.31	5.16	150	28.76 \pm 11.04
Brunswick	1	11.40	5.70	2	29.00 \pm 0.00
Camden	1	13.14	3.29	4	24.00 \pm 0.00
Carteret	4	69.91	13.98	5	23.40 \pm 3.29
Chowan	22	398.50	8.66	46	21.39 \pm 0.49
Columbus	212	2189.23	6.44	340	19.44 \pm 2.65
Craven	17	237.90	8.81	27	26.00 \pm 0.00
Cumberland	180	2322.42	7.37	315	21.55 \pm 1.11
Davidson	1	3.76	1.88	2	36.00 \pm 0.00
Duplin	291	3717.08	7.78	478	24.28 \pm 2.61
Edgecombe	651	8405.89	7.92	1061	20.57 \pm 1.97
Forsyth	5	48.49	6.06	8	32.00 \pm 0.00
Franklin	17	158.26	6.88	23	30.43 \pm 2.45
Granville	3	22.59	4.52	5	27.00 \pm 0.00
Greene	391	4502.92	6.94	649	21.21 \pm 1.66
Guilford	2	16.05	8.03	2	33.00 \pm 0.00
Halifax	122	1177.45	7.05	167	34.25 \pm 3.73
Harnett	269	2124.01	7.93	268	32.96 \pm 7.52

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County	Reported Fields	Reported Acres	Acres Per trap	Traps set (n)	Mean No. of days in the field \pm s.e
Hertford	23	429.03	7.95	54	21.80 \pm 0.41
Hyde	6	135.12	12.28	11	23.00 \pm 0.00
Johnston	1387	12025.75	6.59	1825	22.40 \pm 4.09
Jones	37	585.52	8.13	72	21.00 \pm 0.00
Lee	2	3.39	0.85	4	28.00 \pm 0.00
Lenoir	183	2898.91	7.40	392	25.23 \pm 5.03
Martin	48	716.13	8.43	85	28.74 \pm 0.68
Montgomery	2	29.59	7.40	4	23.00 \pm 0.00
Moore	7	71.10	5.93	12	28.00 \pm 0.00
Nash	1485	12326.92	6.39	1928	21.44 \pm 4.56
Onslow	41	495.31	8.54	58	27.64 \pm 1.56
Orange	1	3.41	3.41	1	28.00 \pm 0.00
Pasquotank	3	31.52	3.94	8	23.50 \pm 0.93
Pender	10	128.19	9.86	13	25.00 \pm 0.00
Pitt	359	4042.27	8.55	473	21.29 \pm 1.55
Richmond	5	101.44	5.97	17	21.00 \pm 0.00
Robeson	145	2081.39	9.82	212	22.64 \pm 2.51
Rockingham	1	15.61	7.81	2	33.00 \pm 0.00
Sampson	1277	15933.13	7.42	2146	26.44 \pm 3.93
Scotland	21	608.51	12.68	48	20.25 \pm 3.45
Stokes	18	78.41	3.14	25	25.80 \pm 1.00
Tyrell	13	96.93	9.69	10	21.00 \pm 0.00
Vance	3	41.18	10.30	4	27.00 \pm 0.00
Wake	246	1720.20	7.23	238	25.08 \pm 4.14
Wayne	589	6210.71	10.20	609	26.22 \pm 3.12
Wilson	1261	10262.35	7.18	1429	23.90 \pm 7.97
Yadkin	2	3.73	1.87	2	28.00 \pm 0.00
TOTAL	9499	98,073	7.36	13,331	23.62 \pm 1.82

Regulatory sites

Sweet potato regulatory sites, including but not limited to storage facilities, processing plants, micropropagation units and greenhouse operations growing ornamental sweet potatoes were surveyed all year long. Because of the inter and intra state movement of sweet potatoes these regulatory sites are a high risk pathway for the introduction of sweet potato weevil from infested areas in and outside the state. Universal Moth Traps (UMT) or bucket traps (Figure 13-B) were used at these sites, instead of the conventional green boll weevil traps used in the field, because of the higher trapping efficiency. For these operations, a minimum of two (one inside and one outside) and a maximum of four traps were set per operation. Traps were placed in major strategic locations where sweet potatoes are stored and/or in and around the locations outside the buildings where sweet potatoes are loaded or unloaded. Lures were changed in each trap once a month and data collection was done using the same procedure detailed for the field surveys. A total of 149 regulatory sites were surveyed in 17 counties. **No weevils were found in storage facilities during the 2015 season.**



Figure 13 Sweet potato weevil traps.

A) Green boll weevil trap baited with sweet potato weevil lure used to survey sweet potato fields and, **B)** Universal Green Moth Trap used to survey in storage facilities and the NC sweet potato quarantine area.

Quarantined area surveys

On February 9 and 10, 2015, a detection grid consisting of 398 universal moth traps (bucket traps) was set in a high density hexagonal grid pattern in the North Carolina sweet potato weevil quarantined area to determine the spatial and temporal distribution of sweet potato weevil (*Cylas formicarius*) populations (Figure 14). Surveys will be conducted for two years and the information obtained will be used to plan and coordinate a sweet potato weevil eradication program in the area. This project (funded by the Specialty Crop Block Grant Program, USDA Farm Bill 2014) will continue through 2016. In 2015, 8959 data points were collected from bi-weekly trap checks. From this information we determined the presence of 11 and 4 population

clusters in New Hanover and Brunswick counties respectively. These population clusters will be the focus of our surveys in the quarantine area in 2016.

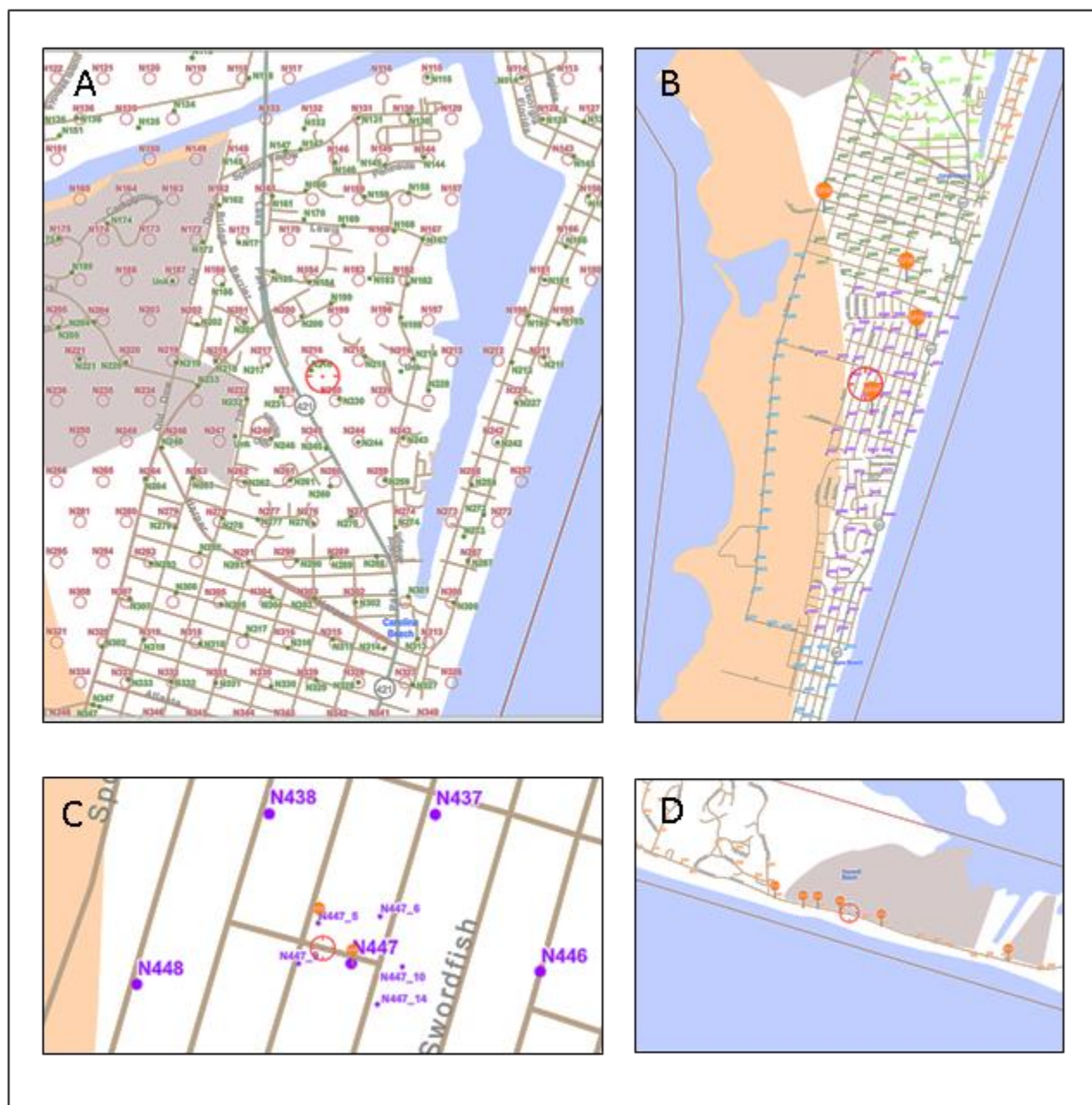


Figure 14 Sweet potato weevil quarantine area trapping results.

A and B) Detection grid showing the target circles (red circles) and the actual trap site in the Carolina/Kure Beach area (green dot with green label), C) population clusters with a delimiting grid in New Hanover County and D) in the Caswell Beach area in Brunswick County.

Emerald Ash Borer Program

The emerald ash borer (*Agrilus planipennis*) (EAB) is a serious pest of forest trees affecting primarily trees of the genus *Fraxinus* (ash trees). It was first detected in 2002 in the United States and is believed to have been introduced in wood packaging material from China. Since it was first detected, EAB has spread throughout most of the eastern United States. Although their natural spread is limited to an average of 5 miles per year, rapid spread of EAB is attributed to the interstate movement of infested material such as firewood. In the summer of 2013, EAB was discovered in four counties of north-central North Carolina (Person, Granville, Vance, and Warren) along the Virginia border and contiguous with a known infestation in that state, and those counties were quarantined. Prior to commencement of trapping in 2015, EAB was discovered in Wayne County, so it was also quarantined.

As part of the national EAB survey program and in cooperation with USDA-APHIS-PPQ, a survey was conducted in North Carolina in 2015 to determine whether new pockets of EAB infestation exist outside the already established distribution area. This survey was conducted in all but the five EAB-quarantined counties, as shown and detailed in this report.

Trapping methodology and results

Trap site information based on the survey sampling design model developed by APHIS-PPQ and the Forest Health Technology Enterprise Team (FHTET model) was used to create geo-referenced PDF maps using GIS for trap sites in the 95 counties in North Carolina not known to be infested with EAB at the beginning of the survey season. These maps, showing FHTET model target squares and other relevant map data such as roads and waterways, were loaded onto iPads, which were then distributed to permanent and temporary personnel for use in navigation and data collection while setting traps. Personnel from the NCDA&CS-Plant Industry Division (including 9 temporary employees) and the NCDA-Forest Service (NCFS) set approximately 881 traps in 52 counties across North Carolina (Figure 15, Figure 16 and Table 7).

Trap set and pull was performed according to the established APHIS-PPQ 2015 survey guidelines. Briefly, purple prism traps baited with a lure consisting of Z-3 Hexanal were placed exclusively in ash trees at a minimum height of 15 feet. Trap locations were recorded using GPS-enabled iPads. NCDA&CS created “weather radar” style maps using basal tree area data from FHTET, along with known ash tree locations from previous years. Field and staff personnel were trained in visually identifying signs of EAB infestation (such as tree decline, woodpecker damage, splitting bark, epicormic sprouting) and visual surveys were conducted while servicing traps.

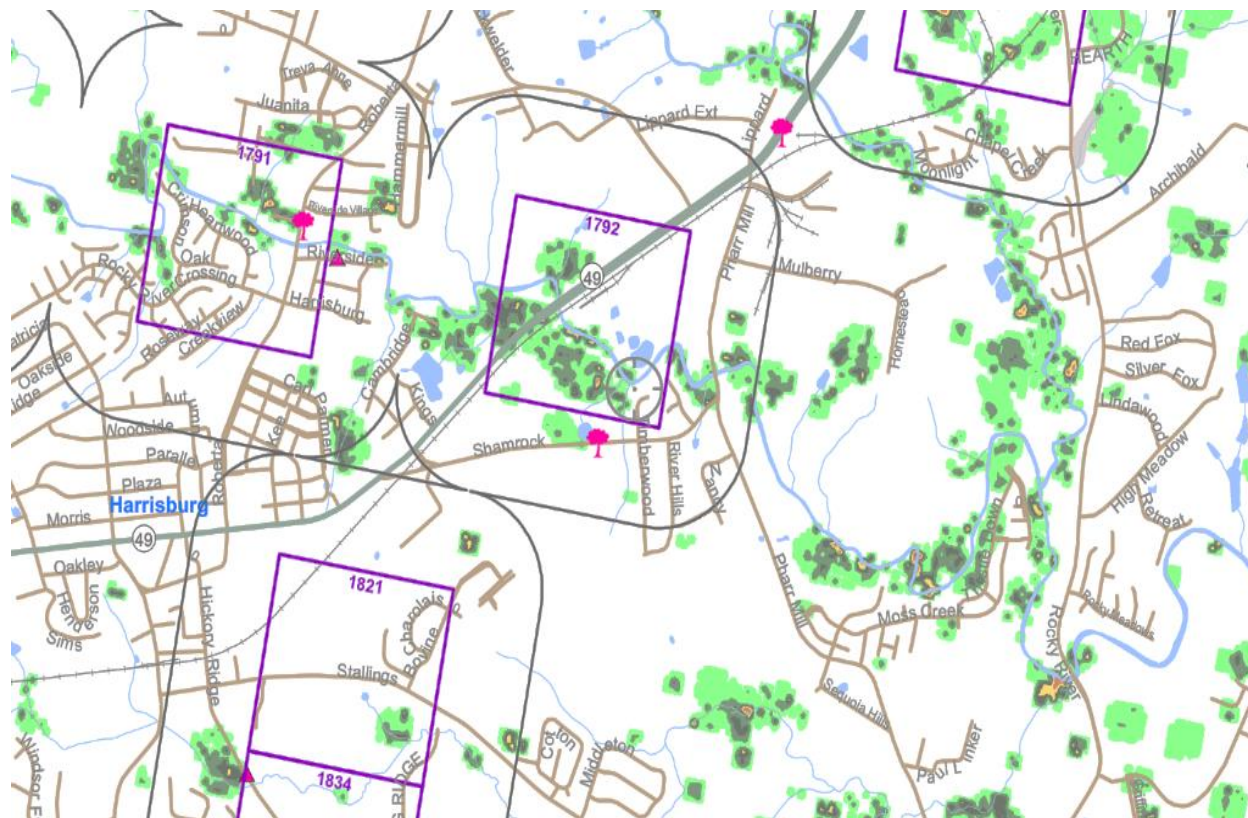


Figure 15 Example of "weather radar" style map used for EAB trapping and visual surveys. Likelihood of finding ash trees is indicated by coloration, using data derived from FHTET. Purple tree symbols denote known ash tree locations, and purple triangles indicate previous year trap locations.

Due to delays in the release of funding and other program duties, personnel began setting EAB traps in June, 2015, well after the beginning of emergence at approximately 450 degree days. Trap pull began in August and was completed in September. Additional discretionary traps were placed by two other entities. USDA-Forest Service placed purple prism traps in Pisgah Forest at sites deemed to be at high risk of introduction, such as campgrounds. NCFS placed traps in state forests, NCFS nurseries, and other sites. NCFS also conducted key extensive visual surveys, particularly south and east of Warren County, and accounted for a number of positive finds. Data for trap locations for both entities is incorporated into Table 7. Trap data has been entered into IPHIS.

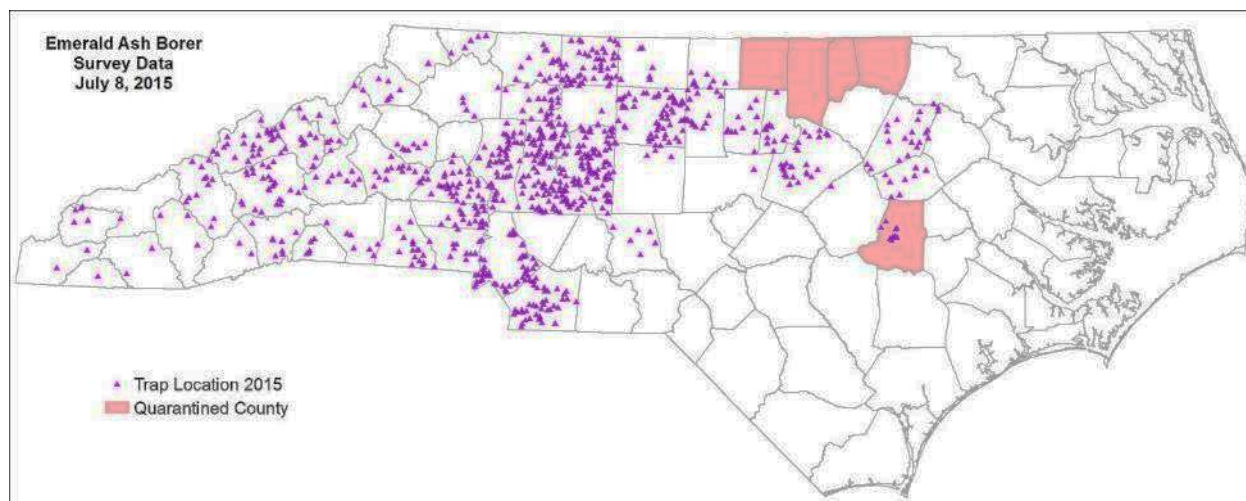


Figure 16 Emerald ash borer traps set in North Carolina for the 2015 survey season.

Table 7 2015 distribution of EAB trap locations by county in North Carolina.

County	Traps Set	County	Traps Set	County	Traps Set	County	Traps Set
Alamance	16	Cleveland	17	Lincoln	23	Rutherford	7
Alexander	1	Davidson	88	Macon	2	Stokes	51
Alleghany	5	Davie	43	Madison	25	Surry	13
Ashe	1	Durham	13	McDowell	9	Swain	1
Avery	2	Forsyth	7	Mecklenburg	47	Transylvania	2
Buncombe	26	Gaston	11	Mitchell	8	Union	42
Burke	16	Graham	5	Montgomery	6	Wake	27
Caldwell	7	Guilford	59	Nash	21	Watauga	7
Caswell	10	Haywood	12	Orange	12	Wayne	15
Catawba	31	Henderson	8	Polk	5	Wilkes	5
Chatham	2	Iredell	50	Randolph	3	Wilson	8
Cherokee	2	Jackson	3	Rockingham	6	Yadkin	22
Clay	1	Johnston	2	Rowan	63	Yancey	13

2015 was a breakout year for EAB finds in North Carolina, all of which have been confirmed by USDA-APHIS-PPQ (Figure 17 and Table 8). In March 2015, EAB was identified by visual survey at a site in Wayne County. In June, NCDA&CS personnel monitoring a colony of *Cerceris fumipennis* in Franklin County discovered that EAB had been captured by this predatory wasp; EAB was found on a recently-set trap in Wake County; and NCFS personnel discovered a positive site in Wilson County. In July, USFS personnel identified a positive EAB on a trap they set in Graham County, and NCDA&CS personnel discovered an EAB-infested site in Orange County via visual survey (NCFS also trapped EAB at a state park in the same county later in the month). In August, trap pulls captured EAB in the following counties: Buncombe, Catawba, Durham, Guilford, Iredell, Lincoln, and Madison. High numbers and symptomatic ash trees in Lincoln County indicate a population of EAB had been established there for several years. A new EAB infestation was discovered in Johnston County in September.

Up until trap pull began in August, the EAB quarantine was extended county-by-county as new infestations were discovered. However, EAB captures throughout the season indicated EAB is widespread across the state and the entire state was quarantined in September.

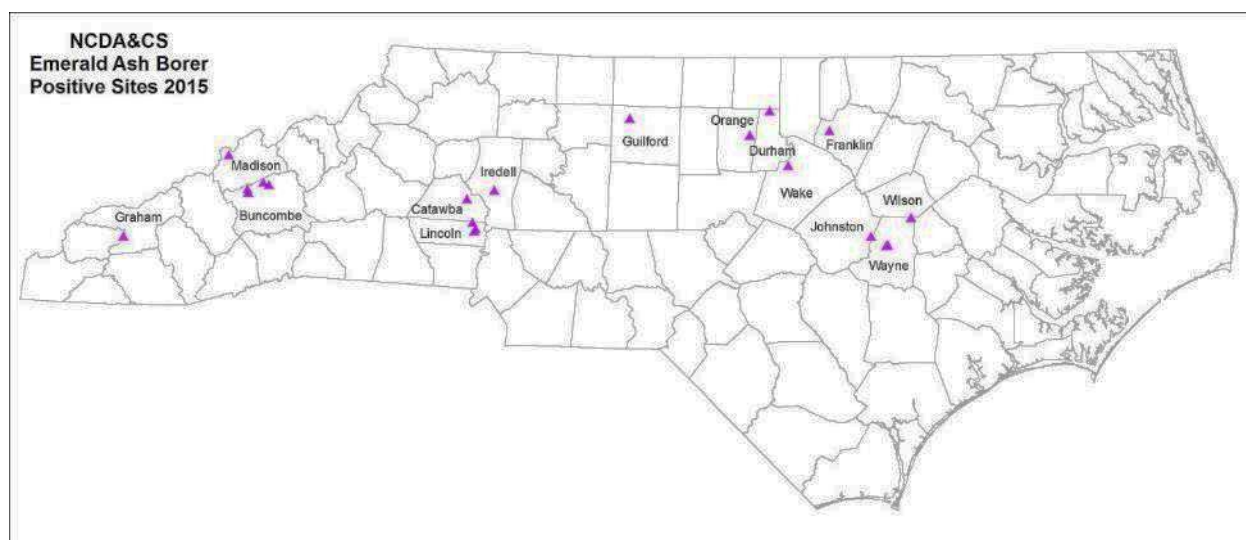


Figure 17 Locations of positive EAB finds in North Carolina in 2015.

Table 8 EAB positive sites in 2015 by county and insect stage detected.

County	Date Detected	Stage		
		Adult	Larva	Pupa
Buncombe	8/11/2015	1		
Buncombe	8/11/2015	1		
Buncombe	8/11/2015	1		
Buncombe	8/11/2015	1		
Catawba	8/11/2015	1		
Durham	8/6/2015	1		
Franklin	6/15/2015	3		
Graham	7/9/2015	1		
Guilford	8/6/2015	1		
Iredell	8/12/2015	1		
Johnston	9/24/2015		1	
Lincoln	8/17/2015	45		
Lincoln	8/17/2015	1		
Lincoln	8/13/2015	17		
Madison	8/4/2015	5		
Orange	7/20/2015	5		
Orange	7/20/2015	4		
Orange	7/10/2015	3		
Wake	6/19/2015	1		
Wayne	6/5/2015	20		
Wayne	6/5/2015	1		
Wayne	3/16/2015	0		3
Wilson	6/15/2015	0	1	
Totals		114	2	3

European Gypsy Moth Program

2015 Gypsy Moth Slow the Spread and Eradication Program

In 2015 NCDA&CS, in cooperation with USDA-APHIS-PPQ and the Slow the Spread (STS) Foundation, carried out an extensive trapping, treatment, regulatory, and alternate life stage survey program aimed at detection and eradication of European gypsy moth (EGM), a major invasive pest of hardwood trees. The program in North Carolina is divided into two different areas, STS and Eradication, as shown in Figure 18.

Trapping

A total of 12,939 traps were set in 95 counties in North Carolina from April to June 2015 and removed from July to September 2015. Traps were baited with disparlure, the female-produced sex pheromone of gypsy moth (2-methyl-7R, 8S-epoxy-octadecane). Trap locations and data were recorded in iPad units. A total of 2,021 adult gypsy moth males were captured in 915 positive traps in North Carolina in 2015. Positive catches were confirmed by the state entomologist and entered into the gypsy moth trapping database at Virginia Tech. Final results of these surveys are shown in Table 9.

Male moth captures in 2015 were significantly higher than in the last two years, with two distinct pockets of high captures along the Virginia-North Carolina border (Figure 20). Cyclical fluctuations may explain the increase. Multiple treatments and a number of delimiting grids are proposed for 2016 to follow up on high-capture locations. Additionally, a large infestation was discovered on the Outer Banks of North Carolina, which will require treatment and trapping as well (see “Hatteras Infestation” below) (Figure 21 and Figure 22).

Per 2015 USDA-APHIS-PPQ protocol as stipulated in the cooperative agreement (15-8237-0864-CA), trapping surveys were conducted in the Eradication area (all non-STs area) as shown in Figure 18. Delta traps were set in an area-wide grid of 1 trap per 3 kilometers, with some areas being trapped at one trap per 500 meters if there was a suspected EGM population. Funding provided by USDA-APHIS-PPQ and the state of North Carolina was used to employ 14 temporary employees, buy the necessary survey supplies (including traps, lures, iPads, and office supplies), and for operational expenses (including fuel and maintenance for survey vehicles).

In the STS area, 8 contractors set traps in 22 bid units, according to site data provided by the STS Foundation in cooperation with Virginia Tech. Delta traps were set in an overall grid of 1 trap per 2 kilometers along the northern portion of the STS area; all other portions of the STS area were trapped at a density of 1 trap per 3 kilometers. Locations with high catches the previous year or areas under evaluation from treatments in previous years were surveyed in a 500-meter grid utilizing high-density milk carton traps.

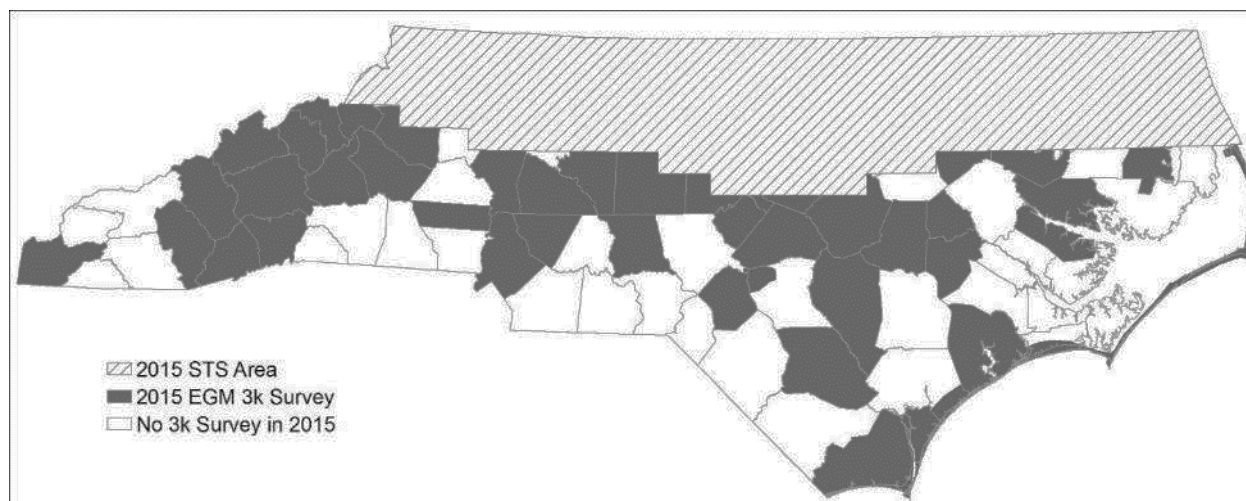


Figure 18 NC 2015 European Gypsy Moth (*Lymantria dispar* L.) survey areas. Shaded counties indicate areas in which EGM 3k grid surveys were conducted. Hatched areas indicate the Slow the Spread Survey areas.

Counties to be trapped in 2015 were determined using the NCDA&CS Master Survey Plan (Figure 19). Some adjustment was given according to known increases in risk of spread or potential population establishment.

Master Survey Plan, NCDA&CS APHIS Gypsy Moth Program

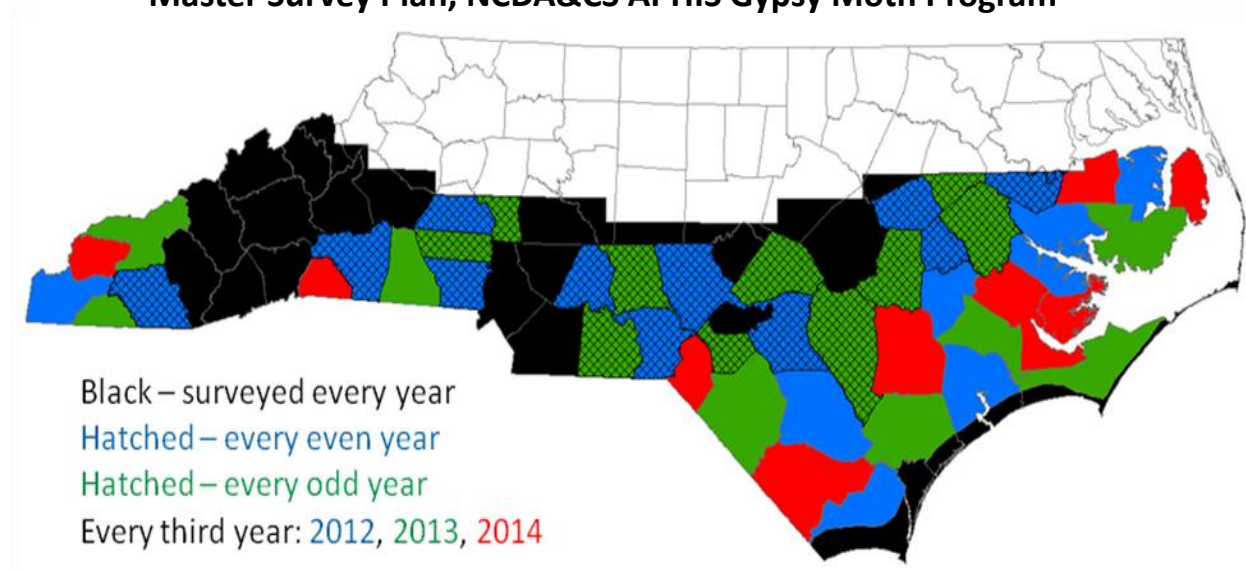


Figure 19 NCDA&CS EGM Master Survey Plan. Every third year rotation extended into blue counties in 2015.

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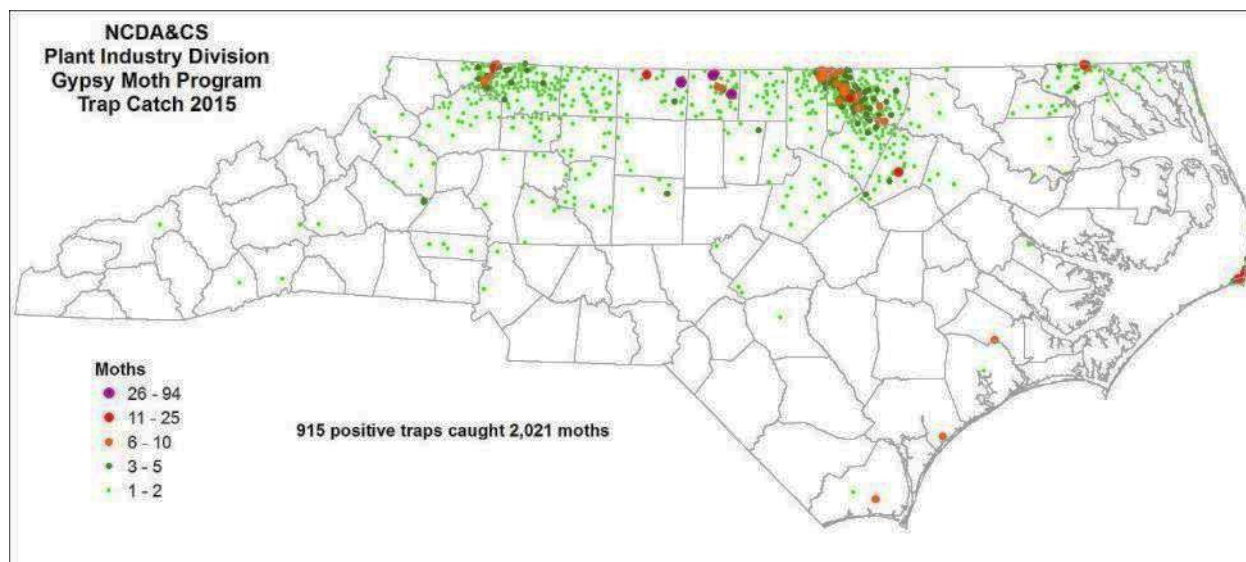


Figure 20 North Carolina gypsy moth trap catches in 2015.

Table 9 2015 EGM survey results in North Carolina by county.

County	Total Traps	Total Positive	Total Catch
Alamance	125	0	0
Alexander	30	0	0
Alleghany	139	46	118
Ashe	166	2	2
Avery	58	0	0
Beaufort	228	1	1
Bertie	305	3	3
Bladen	248	0	0
Brunswick	228	2	10
Buncombe	150	1	1
Burke	149	7	12
Cabarrus	106	0	0
Caldwell	117	7	7
Camden	158	6	8
Carteret	44	0	0
Caswell	529	60	340
Catawba	5	0	0
Chatham	205	0	0
Cherokee	91	0	0
Chowan	85	0	0
Clay	1	0	0
Cleveland	3	0	0
Columbus	2	0	0

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County	Total Traps	Total Positive	Total Catch
Craven	12	0	0
Cumberland	49	1	1
Currituck	237	17	18
Dare	158	35	98
Davidson	164	11	11
Davie	57	3	3
Duplin	3	0	0
Durham	119	3	3
Edgecombe	149	3	3
Forsyth	125	9	10
Franklin	214	57	79
Gates	230	28	56
Graham	1	0	0
Granville	354	62	152
Greene	79	0	0
Guilford	203	4	5
Halifax	451	6	6
Harnett	172	2	2
Haywood	95	0	0
Henderson	90	1	1
Hertford	229	8	9
Hoke	109	0	0
Hyde	10	0	0
Iredell	173	2	2
Jackson	99	0	0
Johnston	229	1	1
Jones	20	4	20
Lee	74	1	1
Lenoir	107	0	0
Lincoln	87	4	5
Macon	8	0	0
Madison	100	0	0
Martin	123	0	0
McDowell	96	1	1
Mecklenburg	166	2	2
Mitchell	57	0	0
Montgomery	128	0	0
Nash	269	37	70
New Hanover	76	0	0

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County	Total Traps	Total Positive	Total Catch
Northampton	360	1	1
Onslow	138	1	1
Orange	182	5	8
Pamlico	1	0	0
Pasquotank	154	1	1
Pender	69	11	33
Perquimans	152	2	2
Person	256	21	23
Pitt	3	0	0
Polk	1	0	0
Randolph	206	4	6
Richmond	1	0	0
Robeson	5	0	0
Rockingham	439	28	113
Rowan	154	5	6
Rutherford	1	0	0
Sampson	274	0	0
Scotland	4	0	0
Stanly	3	0	0
Stokes	260	36	39
Surry	280	103	157
Swain	2	1	1
Transylvania	59	1	1
Tyrrell	66	0	0
Union	3	0	0
Vance	191	105	305
Wake	247	12	12
Warren	388	98	205
Washington	42	0	0
Watauga	97	2	2
Wayne	167	0	0
Wilkes	229	26	27
Wilson	39	0	0
Yadkin	100	15	17
Yancey	72	0	0
Total	12939	915	2021



Figure 21 EGM infestation in Buxton, North Carolina, late May 2015.

Hatteras Island Infestation

The heavy infestation shown in Figure 22 was found to cover approximately 60 acres in the Buxton area along Hwy 12 near the Buxton Woods Coastal Reserve on Hatteras Island. High capacity “green bucket” traps were placed in the core of this area in an attempt to capture male moths before they mated with females. Despite capturing over 25,000 moths, females were observed to be laying eggs extensively in the core area. Plans for treatment in 2016 have been proposed.



Figure 22 Mass delimit trapping results for Buxton EGM infestation.

Male moth captures taper down to nearly none as one gets further from the core of the infestation.

Treatments

Four mating disruption treatments were conducted in North Carolina in 2015, all in cooperation with the USDA-Forest Service in the STS area (Table 10 and Figure 23). Each site received one dose of Disrupt II pheromone flakes at a rate of either 6 grams per acre or 15 grams per acre, as shown in Table 10. These sites will be trapped in 2016 to determine the efficacy of the treatments.

Table 10 2015 gypsy moth mating disruption treatment rate, site location, and acreage.

Site name and rate	County	Acres
Cluster Springs (15g)	Person	7173
Cluster Springs (6g)	Person	6867
Hurdle Mills (6g)	Person	5116
Pilot Mountain (15g)	Stokes	762

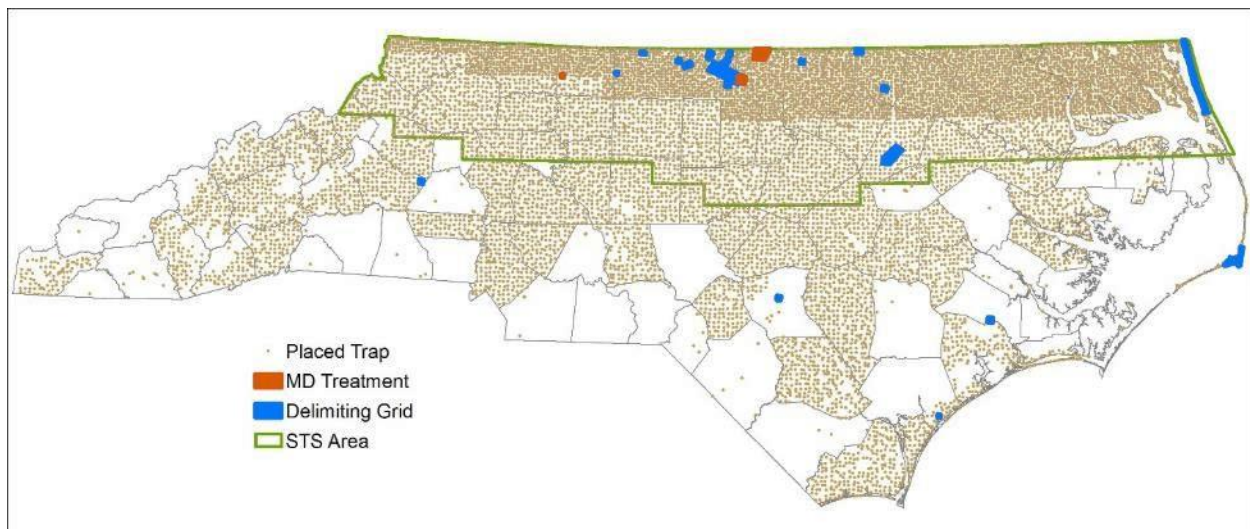


Figure 23 2015 EGM treatment sites (red) along with delimiting grids and all other traps set.

Regulatory

The gypsy moth program also seeks to mitigate the risk of artificial introduction and spread through a comprehensive regulatory program. An area that is generally infested is quarantined so that the movement of certain high-risk articles, such as logs, outdoor household articles, and nursery plants, is strategically restricted per USDA-APHIS-PPQ regulations. In North Carolina, Currituck and a small portion of Dare Counties were quarantined in 1988. A map of the North Carolina gypsy moth quarantine area is shown in Figure 24.

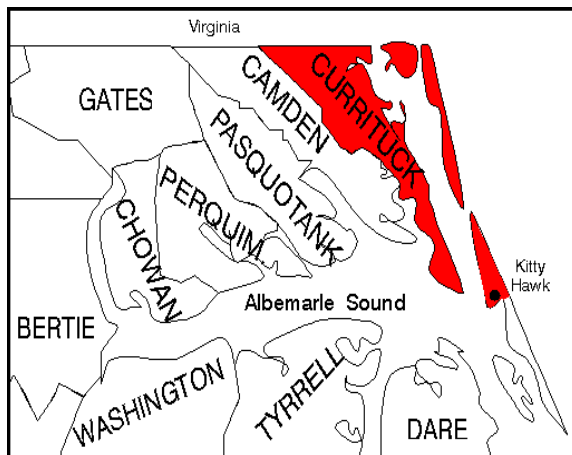


Figure 24 Gypsy moth quarantine in North Carolina shown in red.

Regulated articles may be moved from quarantined to non-quarantined areas if the appropriate personnel undergo training and submit to the stipulations of a Compliance Agreement with NCDA&CS. These compliance agreements require inspection and/or treatment of articles to ensure that they are free of gypsy moth life stages. A number of businesses and individuals received training for new staff and several new Compliance Agreements were issued.

Public education efforts are also an important part of the regulatory program. Staff visits NC Cooperative Extension and NC Forest Service offices to update county personnel on program changes. Also, program personnel monitor all high-risk locations in the STS program area by the placement and removal of traps.

The regulatory program is enduring a time of transition as USDA-APHIS-PPQ, the federal granting agency, has steadily decreased gypsy moth regulatory grants. NCDA&CS' dedicated regulatory position no longer exists, though the person who previously held that post has assumed different responsibilities on our staff and remains able to assist with gypsy moth regulatory tasks. The future character of the program will be determined in part by USDA-APHIS-PPQ funding for this program.

Alternate Life Stage Surveys

Alternate life stage surveys were conducted at two locations, both within the GM-STS area. A survey was conducted near Ruffin in Rockingham County at the site of a 61 male moth capture site, during which one viable gypsy moth egg mass and another spent one were detected. Another survey was conducted at a 94 male moth capture site near Providence in Caswell County, during which one viable egg mass was detected. Due to this indication of reproducing populations, both sites are proposed to be treated with Btk in 2016.

Walnut Twig Beetle Program (Thousands Cankers Disease of Walnuts)

Thousand cankers disease (TCD) is a serious disease of forest trees affecting primarily black walnuts (*Juglans nigra*) and butternuts (*Juglans cinerea*) (Figure 25). The disease is characterized by a large number of “cankers” (dead tissues) on branches and stems causing dieback and, in severe cases, tree mortality. TCD is spreading rapidly through the Eastern United States and has been reported in Virginia and Tennessee, and in early 2013 in Haywood County in North Carolina. As a result of TCD presence in Haywood County, the entire county was quarantined and the movement of firewood and other regulated commodities restricted in that area. The NCDA&CS has been conducting TCD surveys along these border areas in North Carolina since 2011. The present information is a summary of our 2015 survey results.

Methodology and results.

Walnut Twig Beetle (WTB), *Pityophthorus juglandis*, surveys were conducted in North Carolina from June 1 to September 1, 2015. Visual survey data from previous years was used to determine the location of declining walnut trees. One hundred twenty nine lindgren funnel traps (Figure 26) baited with a male-produced aggregation pheromone (Contech Enterprises Inc.) were set 10-15 feet from declining walnut trees and checked bi-weekly until the end of the surveys (September 1). From these traps, 759 samples were collected and screened for WTB. Because of the highest likelihood of finding WTB along the North Carolina-Tennessee border, traps set in counties along this border were left and samples were collected for a period of 3 months, the longest period for these surveys. Traps in other locations remained in the field for a shorter period of time. Walnut twig beetle lures used in these surveys were changed once after the second month. The location of each trap (GPS coordinates) was recorded with GPS units. Collection cups in traps were filled with marine-type antifreeze to one inch from the bottom of the cup. Every two weeks until the end of the survey season, the content of the collection cup was filtered (paint filters) and the antifreeze content changed. Filtered content was screened for WTB. WTB was not identified in any of the traps that were placed during 2015.



Figure 25 Lingdren funnel trap (four funnels) set on a pole by a walnut tree. WTB traps are baited with a pheromone and used to survey for WTB (right).

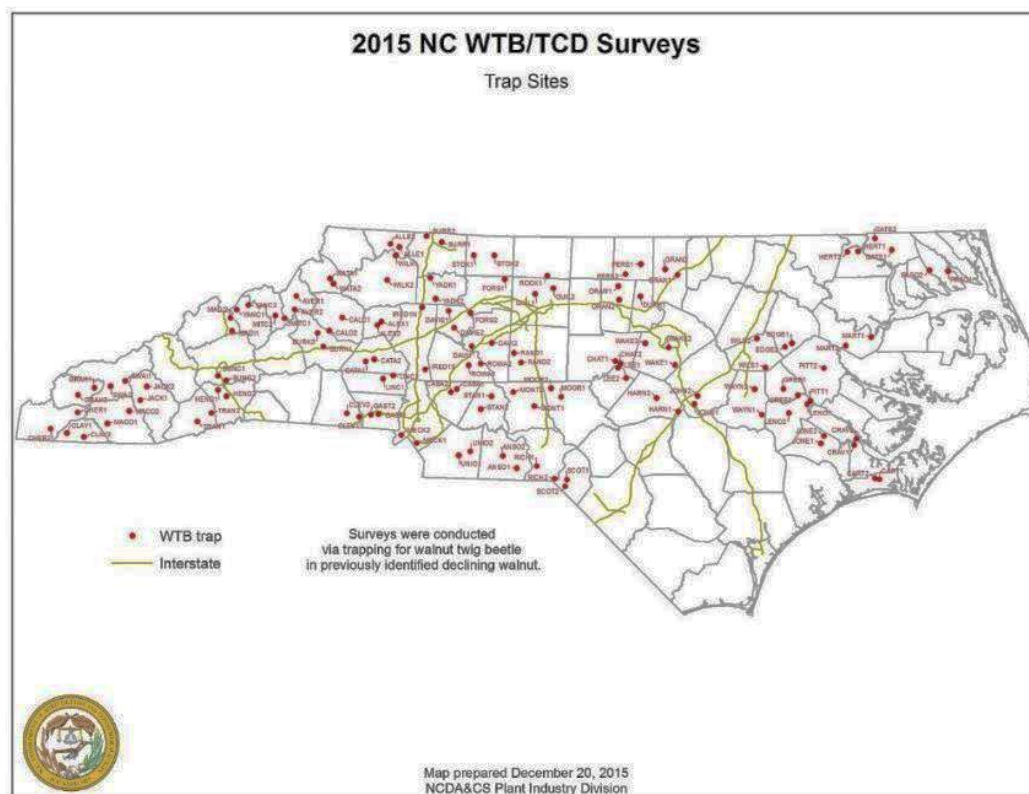


Figure 26 Site location for walnut twig beetle traps in NC.

Imported Fire Ant Program

The Imported Fire Ant (*Solenopsis invicta*) (IFA) continues to be a serious pest in the southern United States with infestations occurring in eleven states. North Carolina is on the leading edge of the expanding range of fire ants. Currently, 73 of North Carolina's 100 counties are either partially or entirely infested. NCDA&CS' objective is to prevent the artificial spread of IFA from infested areas to non-infested areas through regulatory actions.

Methodology and Results

Drive-by surveys (visual inspections) were conducted from March to August 2015 in 14 counties along the current IFA quarantined line (Figure 27). The results of these surveys are shown in Table 11. As a result of these surveys, and the 2014 surveys, new areas were added to the IFA quarantine line in 2015 including Graham, Macon and Halifax counties. To reinforce federal regulations, IFA blitzes were conducted at the weigh stations in Halifax (I-95 corridor in Halifax County), Mount Airy (I-77 Corridor in Surry County) and Hendersonville weigh station (I-26 Corridor in Henderson County) respectively. Drivers were asked about IFA regulated articles and soil samples were collected from regulated articles, processed and sent for chemical analyses (NCDA&CS Food and Drug Protection Division Laboratory) to determine the levels of bifenthrin or any other approved pesticides as required by the federal and state regulations.

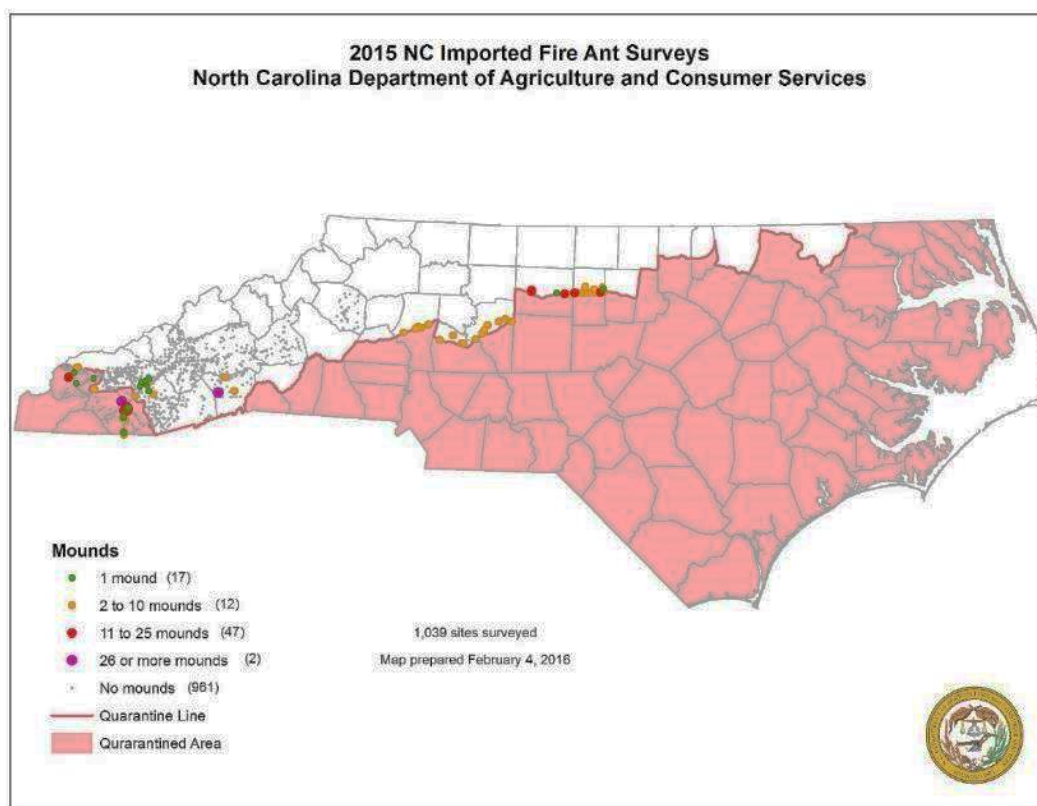


Figure 27 New IFA mound frequency along the quarantined line in North Carolina.

Table 11 Results of 2015 IFA surveys in North Carolina.

County	Miles Surveyed	Acres Surveyed	New Sites	Mounds Observed	Contacts
Alamance	193	37	17	95	1
Buncombe	206	56	0	0	15
Davidson	283	60	7	34	2
Forsyth	90	18	0	0	1
Graham	478	109	4	18	25
Guilford	239	35	6	52	2
Haywood	891	142	0	0	59
Henderson	40	21	1	30	3
Iredell	72	7	2	8	1
Jackson	918	188	4	4	75
Macon	486	188	11	119	48
Rowan	160	25	4	19	2
Swain	340	89	6	10	33
Transylvania	104	35	0	0	9
Total	4500	1010	62	389	276

Cotton Boll Weevil Program

Field surveys for the cotton boll weevil (*Anthonomus grandis*) were coordinated and carried out by the Boll Weevil Eradication Foundation of North Carolina. In 2014, a total of 380,473 acres were reported in 57 North Carolina counties (Table 12). NCDA&CS Plant Industry staff surveyed cotton gins (n=45) and cotton processing facilities in 26 counties (Table 13) using conventional cotton boll weevil traps, similar to those used for sweet potato weevil field surveys. Traps were baited with a male specific sex pheromone and checked once a month.

Table 12. 2015 reported cotton acreage in North Carolina.

County	Acreage	County	Acreage	County	Acreage
Anson	3650.6	Greene	3425.4	Perquimans	11609.1
Beaufort	9189.8	Halifax	45359.5	Pitt	6709.7
Bertie	20905.2	Harnett	9001.9	Richmond	160.2
Bladen	8422.1	Hertford	10139.7	Robeson	7339.2
Brunswick	405.7	Hoke	10079.4	Rowan	859.6
Cabarrus	450.0	Hyde	13505.1	Rutherford	10.0
Camden	410.0	Johnston	7333.6	Sampson	12721.2
Carteret	471.8	Jones	7302.7	Scotland	5434.2
Chowan	9343.1	Lee	308.8	Stanly	11840.8
Cleveland	1211.6	Lenoir	6503.6	Tyrrell	5143.1
Columbus	1115.9	Lincoln	91.2	Union	1585.0
Craven	3440.2	Martin	29735.8	Wake	275.5
Cumberland	5827.0	Montgomery	548.0	Warren	478.4
Duplin	4333.2	Nash	7299.3	Washington	10459.7
Edgecombe	23023.5	Northampton	36365.2	Wayne	7246.3
Gates	12729.9	Onslow	500.2	Wilson	4366.9
Granville	57.6	Pasquotank	1748.1	Total	380,473.2

Table 13. Cotton gin numbers surveyed for cotton boll weevil in North Carolina.

County	Gins	County	Gins	County	Gins
Anson	1	Edgecombe	1	Perquimans	1
Beaufort	1	Hertford	1	Pitt	2
Bertie	4	Hyde	1	Robeson	4
Chowan	1	Jones	1	Sampson	3
Cumberland	1	Lenoir	1	Scotland	1
Duplin	1	Martin	2	Stanly	1
Gates	1	Nash	1	Wayne	2
Greene	1	Northampton	5	Wilson	1
Halifax	5	Pasquotank	1		

Blueberry Export Certification Program

The North Carolina blueberry certification program is implemented by the NCDA&CS Plant Industry Division to help blueberry farmers export their fruit to Canada. The Canadian Food Inspection Agency requires that all fresh blueberries shipped to Canada come from growers enrolled in the Blueberry Certification Program. The program consists of monitoring and control procedures for the blueberry maggot, *Rhagoletis mendax*. Fifty-five North Carolina production areas were monitored (5,617 acres total representing 120 fields) throughout the harvesting and shipping period and were issued certification documents. No blueberry maggots were detected in any of the fresh market blueberries being shipped to Canada in 2015.

Movement of Live Insects for Research, Commercial or Educational Purposes

The NCDA&CS evaluated 128 federal applications, PPQ Permit 526, for the movement of live insects into North Carolina. No permits were rejected in 2015. The large number of applications to move insects to North Carolina reflects the continued market in commercial production, sale, and movement of insects for education, entertainment, and scientific research conducted in North Carolina's academic institutions and the private sector.

Table 14 Entomological quarantine summary for North Carolina in 2015.

Regulatory Species	Quarantines as of December 2015
Walnut twig beetle (<i>Pityophthorus juglandis</i>)	Entire Haywood County. Quarantine area remained unchanged relative to 2014.
Gypsy moth (<i>Lymantria dispar</i>)	Currituck County. Quarantine area remained unchanged relative to 2014.
Emerald Ash Borer (<i>Agrilus planipennis</i>)	In 2015 the entire state of NC was put under quarantine for emerald ash borer.
Sweet potato weevil (<i>Cylas formicarius</i>)	Coastal areas of Brunswick (Caswell Beach) and New Hanover (Carolina Beach and Kure Beach) counties.
Cotton Boll Weevil (<i>Anthonomus grandis</i>)	Not reported in NC. External quarantines established to restrict the movement of regulated articles from infested areas along the Mexico/US border where weevils are present.

Nursery Certification Program

NCDA&CS' Plant Protection Specialists inspected 4,394 nursery dealers and nurseries during the 2015 season. Eleven Stop Sale/Movement notices were issued to prevent the sale of infected or prohibited plants. These plants were either treated, destroyed, or released after lab testing.

A license issued by the NCDA&CS is required by any person selling nursery stock in North Carolina. Nursery stock is defined as "all wild or cultivated plants or parts thereof, trees, shrubs, vines, bulbous plants and roots, grafts, scions and buds." Excluded in North Carolina's definition of nursery stock are "annual plants; cut flowers; tree, field, vegetable, flower or other true seeds; decorative plants or plant parts without roots not intended for propagation; and perennial plants intended for indoor use that are produced in North Carolina." A *nursery license* is required for any person growing and selling nursery stock whereas a *nursery dealer license* is required for any person obtaining and re-selling nursery stock. These licenses certify that plant material has been inspected for and is apparently free from potentially harmful quarantine pests and must be renewed yearly.

The NCDA&CS Plant Protection Section licensed 1,206 nurseries and 3,188 nursery dealers during the 2015 calendar year (Table 15). Of the 1,206 nurseries, 594 were registered nurseries and 612 were certified nurseries. A *registered nursery* has less than one acre of nursery stock and does not sell outside the state. A *certified nursery* has one or more acre of nursery stock and/or sells outside the state.

The nursery dealer industry remained relatively unchanged in the state, continuing to offer quality nursery stock to consumers. The Dollar General licensed 385 of their stores in North Carolina in 2015 and several other chain stores have increased slightly which hopefully indicates an improving economy. The increases in nursery production as well as nursery dealer stability indicates the strength and staying power of North Carolina's nursery industry.

Table 15 Number of North Carolina nursery and nursery dealer licenses by year^w

Calendar Year	Number of Licenses by Category			Total Number of Licenses	
	Registered Nursery ^x	Certified Nursery ^y	Nursery Dealer ^z	Nurseries (Registered & Certified)	Nurseries & Dealers
2013	515	548	2,821	1,063	3,884
2014	590	654	2,782	1,244	4,026
2015	594	612	3,188	1,206	4,394

^wData based on receipt of license fees.

^xRegistered nursery – a location with less than once acre of nursery stock with no sales outside the state.

^yCertified nursery – a location with one or more acres of nursery stock and/or sales outside the state.

^zNursery dealer – a location where nursery stock is sold, usually to the end user, but not actually grown.

The primary objective of Plant Industry's Nursery Program is to facilitate the movement of nursery stock while preventing the introduction and spread of quarantine plant pests into and within North Carolina. The movement of infested nursery stock represents one of the ways plant pests may be moved from one location to another and has the potential to directly impact both wholesale and retail nursery operations. North Carolina works to prevent such outbreaks by coordinating with other states and the nursery industry to bring awareness of threats to the state.

Stop sale/movement notices are issued when high levels of pests and/or prohibited plants are noted. Plants can either be treated and/or destroyed when a stop sale/movement notice is issued. Plants can be released for sale/movement if testing of the material confirms they are free of the suspected pest(s). During calendar year 2015, eleven stop sale/movement notices were issued.

Phytosanitary Certification Program/ 2015 Export Certification Program

Within the Phytosanitary and Export Certification Program, Plant Protection Specialists issue phytosanitary certificates to growers and/or brokers to facilitate movement of agricultural commodities to other states and to other countries. Phytosanitary certificates indicate that inspections and other specific requirements of the importing states or countries have been met. State certificates are used for movement within the United States, and federal certificates are required for movement to another country. Countries and states vary greatly in what they require for various types of commodities such that careful research and interpretation of requirements are needed for each request for phytosanitary certification.

A phytosanitary certificate provides documentation that a plant, plant part, or plant-based product has been inspected and is apparently free of harmful pests. Each state and country has very specific import phytosanitary requirements that are tailored to protect their agricultural industries and natural environment from potentially harmful pests.

The NCDA&CS Plant Protection and Export Certification Specialists facilitate interstate and international movement of plants, plant parts, and plant-based products by issuing both state and federal phytosanitary certificates to North Carolina growers and brokers. State and federal phytosanitary certificates are issued for interstate and international movement, respectively. The NCDA&CS is responsible for implementing the state export program, while the USDA is responsible for implementing the federal export program. However, the NCDA&CS works in collaboration with the USDA to issue federal phytosanitary certificates to support international export of plant-based products from North Carolina.

Primary use of the USDA PCIT (Phytosanitary Certificate Issuance and Tracking) System to issue federal certificates began in October 2009. The number of federal and state phytosanitary certificates issued using the PCIT system is included in Table 16. In 2015, NCDA&CS staff issued 6,743 federal phytosanitary certificates and 561 state phytosanitary certificates. The number of federal phytosanitary certificates issued in 2015 represented a 6.1% decrease from 2014 figures, while the number of state phytosanitary certificates issued represented a 61.2% increase from the previous year. Federal certificates were issued for the movement of commodities to 93 countries, while state certificates were issued for 29 states, Puerto Rico, and the Virgin Islands. The majority of phytosanitary certificates issued were for lumber, tobacco, cotton, cotton seed, Christmas trees, peanuts, nursery and greenhouse plants, sweet potatoes, and sweet potato cuttings.

Table 16 Number of phytosanitary certificates issued through the PCIT¹ system²

Fiscal Year	Federal				State
	Plant or Plant Part	Re-export	Processed Plant Product	Total	Total
2009/2010 ³	1,759	24	0	1,783	205
2010/2011	2,781	21	0	2,808	323
2011/2012	4,221	13	18	4,252	206
CY 2013 ⁴	5,830	15	134	6,658	412
CY 2014	6,980	32	172	7,184	348
CY 2015	6,560	21	162	6,743	561

¹ PCIT = Phytosanitary Certificate Issuance and Tracking (USDA web based application)

² Use of PCIT began in October 2009

³ Fiscal year data

⁴ Calendar year data

Plant Conservation Program

North Carolina Plant Conservation Board

The Plant Conservation Program (PCP) meets quarterly with members of the NC Plant Conservation Board whose seven members are appointed by the Governor and the Commissioner of Agriculture. Members in 2015 included: Kathy Schlosser (chair) Les Hunter, Steve Henson, Peter White, Alexander Krings, David Hyatt, and Jonathan Lanier.

Peter White of the NC Botanical Garden retired at the end of 2014; he will continue to serve pending a Governor-appointed replacement of a North Carolina Botanical Garden representative. Damon Waitt, the current North Carolina Botanical Garden Director attended Board meetings in 2015.

The Board commenced work on developing policies governing activities on North Carolina Plant Conservation Preserves. Various board actions have resolved relatively narrow questions regarding particular uses and has required public access by permit on the preserves. This effort integrates past actions with more specified guidelines for activities on preserves. Included in this document are provisions for plant reintroductions that the Scientific Committee is developing.

North Carolina Plant Conservation Scientific Committee

The Program continues to meet regularly with members of the North Carolina Plant Conservation Scientific Committee. This seven member committee consists, primarily, of positions designated to the committee by law. Members include Alan Weakley (chair), Dennis Niemeyer, Alvin Braswell, Richard Braham, Johnny Randall, Hervey McIver, and Laura Robinson. Alvin Braswell, representing the North Carolina State Museum of Natural Sciences, retired in late 2014. Mr. Braswell will continue to serve on the Committee until he is replaced.

The Committee began work on updating the imperiled plant list following procedures and protocols established during the last update in 2008. The Committee will suggest additions, deletions, and technical changes once PCP staff completes necessary analyses and ensures a thorough review of any changes to trends and threats of individual imperiled species. The Committee also commenced work on developing guidelines for reintroducing plants on Plant Conservation Preserves. The guidelines will include staff-level decisions such as augmentation of existing imperiled plant occurrences and instances where Committee or Board action is necessary.

Plant Conservation Preserve System

Plant Conservation Preserves are lands permanently protected for the conservation of North Carolina's native flora and their habitats. These Preserves are the only state-managed lands selected and designed specifically for plant conservation purposes. The Preserve system consists of 24 preserves located in 18 counties across the mountains, piedmont and coastal plain totaling 13,635 acres (Figure 28).

The Caraway Preserve in McDowell County became the 24th Plant Conservation Preserve. This forty acres in the Blue Ridge Mountains protects the largest population of northern Oconee bells, a species endemic to North Carolina.



Figure 28 Plant conservation preserve system

Preserve Field Trips

Due to concerns about resource damage and plant poaching, PCP allows guided preserve tours only. Staff conducted thirteen guided field trips from March through October at Boiling Spring Lakes, Camassia Slopes (TNC/WRC), Redlair, White Woods, Eno Diabase Sill, pending preserve McIntosh Bay, TNC's Antioch Bay, Tater Hill, Bluff Mountain, and visiting the neighbors of Cedar Mountain Bog. All field trips are open to the public. Each trip provided participants the opportunity to observe rare plants, while also learning more about land management and ecological stewardship. Participants included special guests, volunteer stewards, and co-hosts from some of our partner organizations.

Land Conservation Funding

PCP staff prepared grant applications to the Clean Water Management Trust Fund (CWMTF) to expand Bat Fork Bog Preserve by seven acres in Henderson County, to expand Paddy Mountain Preserve by 100 acres in Ashe County, and Cedar Mountain Bog Preserve by 100 acres in Transylvania County. The Program proposed these projects in order to protect additional imperiled plant occurrences and provide imperiled plant habitat buffer. An additional application for the Austin Tract in Scotland County protects Federal endangered Canby's dropwort (*Oxypolis canbyi*), a species that grows on one site in North Carolina: a rare clay-based Carolina bay. The CWMTF board funded the Paddy Mountain expansion, and the Austin Tract. The Bat Fork Bog expansion is on their provisional list.

In support of the CWMTF grants, PCP staff applied for three land acquisition projects under the US Fish and Wildlife Service Section 6 Recovery Lands Program. This program funded Bat Fork Bog and Austin Tract projects in support of recovery efforts for Federally listed bunched arrowhead and Canby's dropwort.

Site Acquisition Planning

A systematic and comprehensive evaluation of site protection needs was recently updated. This "Portfolio of Important Plant Conservation Areas" continues to guide our efforts in working with land owners and managers across the state to better protect these critical sites. PCP staff has begun updating

the portfolio in a Geographic Information System (GIS). This new version will include a scripted model generated in ArcGIS that reduces selection process time and effort, plus allowing for future changes in plant population statuses or newly discovered sites to be easily evaluated. The model will be an important part of a more consistent and efficient workflow for this necessary planning task.

United States Fish & Wildlife Service (USFWS) Partnership

The Plant Conservation Program and USFWS continued a long-standing cooperative agreement related to the recovery of endangered and threatened species in North Carolina. Grant funds obtained under this cooperative agreement provide critical funds to North Carolina each year. This agreement provides funding for one full-time research specialist staff position. A portion of the remaining funds supported PCP temporary employees for parts of the year. The funding from this partnership supports imperiled plant monitoring, preserve management targeted towards federally-listed plant species, and protected plant permit evaluation and issuance.

Partnership and Outreach Projects

The Plant Conservation Program is a member of several statewide or regional conservation partnerships and staff participates in these partnerships as time allows. PCP staff participated in the Greater Uwharries Conservation Partnership's "Short Leaf 101" workshop for forest landowners and professionals, totaling approximately 150 people, by speaking on this species' ecology and natural history. Additionally, PCP staff worked with the Bog Learning Network by organizing and participating in International Bog Day. Speakers from PCP, universities, as well as state and federal agencies presented to approximately 100 Brevard-area residents for this two-day event. PCP staff also assisted the Friends of Plant Conservation (FoPC) annual meeting by delivering presentations, organizing field trips, and assisting in participant registration.

PCP continued to work closely in partnership with conservation organizations and land trusts across the state in land acquisition with the Blue Ridge Conservancy, Catawba Lands Conservancy, Carolina Mountain Lands Conservancy and The Nature Conservancy. Also of note, PCP has expanded its partnerships with the North Carolina Museum of Natural Science, the NCDA&CS Research Stations, and the North Carolina Forest Service offices and personnel around the state. In addition, staff regularly reaches out to the public with special presentations and by filling information requests.

PCP staff supported and helped plan the Rare Plant Conservation Discussion Meeting in March, cohosted by the North Carolina Botanical Garden, the North Carolina Zoo, and PCP. These meetings provide a venue for presentation of new research as well as to hold discussions and pose questions regarding rare plants. These meetings are attended by faculty and students of multiple universities as well as staff from numerous state and federal agencies, and provides a good opportunity for PCP to keep current and potential partners abreast of important news related to PCP.

Regulatory Programs

The Program is responsible for the protection and conservation of 419 plant species across North Carolina, of which 27 are also federally listed. Program staff meets quarterly with an interagency panel to review permit requests for projects affecting these protected plant species. Program staff continues to review requests for permits from individuals or institutions requesting to move or collect protected plants, including all state and federally listed plant species. This permit requirement applies to transplant and rescue projects, nurseries which propagate and sell protected species, public educational exhibits, as

well as many scientific research projects. The review process incorporates input from the US Fish and Wildlife Service and the North Carolina Natural Heritage Program. Fifty-three permits were issued and several additional requests were evaluated.

- *Venus Flytrap*

Venus flytrap is an imperiled species endemic to North Carolina and South Carolina and subject to considerable poaching pressure in areas near Wilmington, North Carolina. In 2014, staff received approximately 150 flytrap plants confiscated by Boiling Spring Lakes Police and placed them in the care of Becky Westbrooks, instructor at Southeastern Community College in Whiteville. PCP planted approximately half of these at Boiling Spring Lakes Preserve in 2015 and partnered with the North Carolina Botanical Garden to propagate the remaining for future conservation efforts.

- *Ginseng*

American Ginseng harvest and exports from North Carolina continued under regulations adopted by the Plant Conservation Board. Without monitoring by the Program, harvest and export from North Carolina will not be allowed by federal authorities who have listed this plant under the Convention on International Trade in Endangered Species (CITES).

NCDA&CS generated over 390 export certificates of wild collected ginseng for the 2014-2015 season. There were a total of 11,674 pounds (dry) harvested during the season consisting of Wild, Wild-Simulated, and Woodsgrown from a total of over 13,000 dealer-harvester transactions. PCP issued a total of 40 dealer licenses for this season.

PCP staff also participated in the 2015 annual Ginseng Marking Blitz in the Great Smoky Mountains National Park, a collaborative effort between NCDA&CS and the Park. Removal of plants is illegal in the US National Parks without a permit. Each year thousands of wild American ginseng plants are marked with a permanent dye so that if the plants are poached and attempted to be sold for export, they can be identified as illegally poached from the park.



Figure 29 American ginseng root

PLANT CONSERVATION PRESERVE MANAGEMENT & MONITORING ACTIVITIES

The Program continues striving to manage Preserves for the benefit of the rare plant species and habitats present on these sites and to conduct sufficiently detailed monitoring to determine the status of rare species at these sites.

Preserve Management Highlights

- ***Hebron Road Plant Conservation Preserve:***

The primary goal at this preserve is to create more open woodland-prairie conditions to promote the smooth coneflower (*Echinacea laevigata*) population. This site has one of the highest woody stem densities of all managed coneflower sites in the region, the majority of which are small saplings. Our best method for creating these open conditions, and to thus promote flowering in the rare plant community, in the most natural way possible is with prescribed fire. The entire conservation area exceeds 80 acres but only approximately 5 acres have been successfully prescribed burned (four times from 2011-2015). PCP staff, with the help from NC Forest Service burned this 5 acre block in April 2015. Extensive fire lines have been constructed and burn units delineated to expand future prescribed burns within the preserve.

- ***Eno Diabase Plant Conservation Preserve:***

Several additional acres of hand clearing of small stems and brush sprouting after previous fires was removed in priority areas including the Harrelson tract, Goldston tract, Penny tract, and Wanderlust Rd. tracts. Taken together these brush piles totaled several dozen. Additionally, PCP staff also cut several dozen larger (10" dbh and larger) loblolly pine trees from the perimeter of the open prairie portion of the Harrelson tract, which hosts Durham County's largest *E. laevigata* population. The tree tops were piled to be burned in early 2016 with the logs being dispersed to cause as little suppression to the forbs as possible. PCP staff and supervised volunteers treated a number of infestations of invasive plants on this preserve, including *Microstegium vimineum*, *Lespedeza cuneata*, *Ailanthus altissima*, and *Daucus carota* during this period. We also created a series of schematic maps of known invasive infestations to visualize the total occupied area of each species as well as the combined impact on the preserve parcels of all of the invasive plants taken together. These maps are being used for tracking treatment times and we plan to use it for quick monitoring of successes and efficacy of treatments to better guide management efforts.

- ***Cedar Mountain Bog***

The Cedar Mountain Bog Preserve has an extant population of mountain sweet pitcher plant (*Sarracenia jonesii*) which we have been monitoring and reporting on since PCP acquired the property in late 2011. From our files on the species, we noted that during the 1990s several individuals were removed from the Cedar Mountain Bog and taken to the Atlanta Botanical Garden as part of a rescue project until the poaching problems noted there were dealt with. This year PCP Staff coordinated with the Atlanta Botanical Garden to reintroduce these individuals back into the bog now that the property is protected and under management. PCP staff re-introduced approximately 20 individuals into the bog with GPS coordinates recorded for careful monitoring. PCP Staff cut additional rhododendron from the southwest corner of the bog opening, on the slope above the lower-lying boggy area for the purpose of decreasing the intercepted rainfall that these plants are certainly causing as well as the water their roots take up from the soil. The cut stems were piled into approximately one dozen piles and burned on site. This cutting and burning method is effective in reducing the biomass without disturbing the soil or creating

erosion concerns. We anticipate an increase in sunlight, and possibly additional water availability, for one *S. jonesii* and state rare mountain purple pitcher plant (*Sarracenia purpurea* var. *montana*) subpopulation and will be monitoring this and the other subpopulations in the bog for any response via flower production.

- ***Pondberry Bay Preserve***

PCP staff, with the help of the NC Forest Service, conducted four prescribed burns totaling 295 acres in the uplands of White Woods Rd Preserve (aka Pondberry Bay). An additional 95 acre block was prepared late in 2015 to be burned, having not been burned by PCP staff since the property was acquired. Unfortunately, the appropriate weather parameters did not materialize; however we hope to burn this in early 2016. Previously collected wire-grass seeds from the preserve were scattered in one of the 2014 logged blocks close to the bay to promote herbaceous understory recovery. PCP Staff continued to cut loblolly pines, an additional two dozen, from the bay itself as part of an ongoing removal of loblolly from what would otherwise be a pond cypress savanna.

- ***Harvest Field Preserve***

Seeds collected from Harvest Field in 2013 were sown directly on site after pretreating the surrounding area to remove all maple and sweet gum stems from within a few meters. These were planted near the seeds planted in 2014, also near the naturally occurring individual in the interior of the property. PCP staff retreated these planted areas from 2014 and 2015 later in the year to avoid competition of resprouting woody stems. Responding to heavy rains in the summer, PCP staff installed nine water bars along firelines on the north side of the Harvest Field Preserve to address erosion concerns. We also cut maple and sweetgum saplings which were then treated with herbicide to avoid resprouts in the interior of the property near where Schweinitz sunflower (*Helianthus schweinitzii*) has reemerged.

- ***Mineral Springs Barren***

PCP staff hand removed several acres' worth of small saplings from roadside edges at Mineral Springs Barren Preserve under the powerlines which are immediately adjacent to dense patches of *H. schweinitzii* and state-listed Georgia aster (*Symphyotrichum georgianum*). We cut and piled the very dense brush on site for later pile burning. We also established a new fire line for a block that has not been burned in 10+ years yet has records of *Baptisia alba* and other prairie-like species. Burn plans and other supporting materials were also prepared for this unit.

- ***Redlair Preserve***

Over 1000 volunteer hours combatted various occurrences of invasive exotic plant species on this 730 acre preserve. This tract is at the urban-rural interface of Charlotte, NC and consequently has multiple vectors of invasion including riparian flooding, former homesites, and adjacent residential development. In late 2015, PCP Staff were joined by volunteers to reroute existing fire lines at the Adam Hunter Prairie of Redlair Preserve, also a *H. schweinitzii* site. Staff and volunteers also cut and brush piled many trees along the woodland perimeter of the prairie opening to begin to soften the artificially abrupt boundary between the open grassy/forb-filled area and the wooded edge. This location is useful for demonstrating a process whereby xeric woodlands or even more open prairies succeed into mesic forests, where canopy species like oaks and hickories are joined by an under and midstory of maples, beeches, sweetgums, tulip poplars, devoid of oak or hickory regeneration.

PCP staff in conjunction with the Redlair Stewardship Committee, hired a technician, Jess Richardson, who will address various management concerns on Redlair. This position will become full-time and permanent after the Redlair Foundation is fully funded and the Department has secured a full-time position.

- ***Boiling Spring Lakes***

PCP staff targeted mechanical mulching of heavy shrub layers, primarily in areas that are difficult to burn due to wildland–urban interface. Using the program’s skidsteer and mulching attachment, PCP staff was able to install 9707 ft. of fire breaks using the same machinery and thus over 150 acres in and around rough-leafed loosestrife (*L. asperulifolia*) subpopulations, supporting fuel reduction efforts for the City of Boiling Spring Lakes, and enhancing long leaf pine habitat for Federal and State imperiled species such as the rough-leafed loosestrife and red-cockaded woodpecker.

- ***Bat Fork Bog***

In March of 2015, PCP coordinated with NC Forest Service staff who brought a dump truck and small excavator and removed the overburden soil from this small “levee”. PCP staff prepared the site with a silt fence to stop the loosened soil from falling into the ditch with the bunched arrowhead (*Sagittaria fasciculata*). The excavated soil was approximately equal to 10 ft. wide x 50 ft. long x 1-2 ft. deep, or approximately 500-1000 ft³. The excavated soil did not leave the site, but rather was used to fill a very similar-sized swale between the preserve’s eastern property boundary and a neighbor’s property. We worked with the NC Forest Service staff to create as natural a landscape as possible in the disturbed area by including tree “tip-up” areas to replicate the primary natural cause of medium-sized soil disturbances in wet forests. Two of these tip-up areas were created by pushing over canopy and sub-canopy trees with the excavator; a third was created by digging a similar-sized bowl in the soil. We did not breach the ditch wall for not wanting to have the water siphon away from patch C, but we did observe ground water filling the deeper areas immediately and more so overnight.

In late September, twelve or more “new” *S. fasciculata* plants were observed in the lowest dug swales in the removed levee area, now in between patches C and B. It appears that these have popped up from the exposed hydric soil as opposed to being washed over from the ditch. PCP staff plans to monitor this area closely for any undesirable plant species that may germinate in the disturbed soil. As of September, some sparse vegetation had begun to occupy the exposed soil in the restoration area; however, no undesirable species were observed

Rare Species Monitoring

PCP completed intensive monitoring of six federally-listed plant species: smooth coneflower, Schweinitz’s sunflower, bunched arrowhead, mountain sweet pitcher plant, Michaux’s sumac, and rough-leafed loosestrife. Seven smooth coneflower (*Echinacea laevigata*) populations were censused as part of nearly 10 year old efforts to determine population trends; sites with PCP-directed management are increasing, while other sites are stable – decreasing.

Flowering trends for Schweinitz’s sunflower (*Helianthus schweinitzii*), are variable across PCP Preserves and other visited sites. Prescribed burning may have increased flowering numbers of this species at Mineral Spring Barren, and possibly at Harvest Field preserve. A qualitative assessment of bunched arrowhead (*Sagittaria fasciculata*) indicates a stable or increasing population at Bat Fork Bog.

Staff quantified three patches of flowering Mountain sweet pitcher plant (*Sarracenia jonesii*); results indicate that two had a higher number of individuals as compared with 2013.

Rough-leaved loosestrife (*Lysimachia asperulifolia*) monitoring (2010-2015) indicate stable individual numbers for one occurrence, one occurrence with increasing numbers and one occurrence with decreasing numbers. Winter burning or hand clearing around individuals appear to be management prescriptions that increase or stabilize populations of this species.

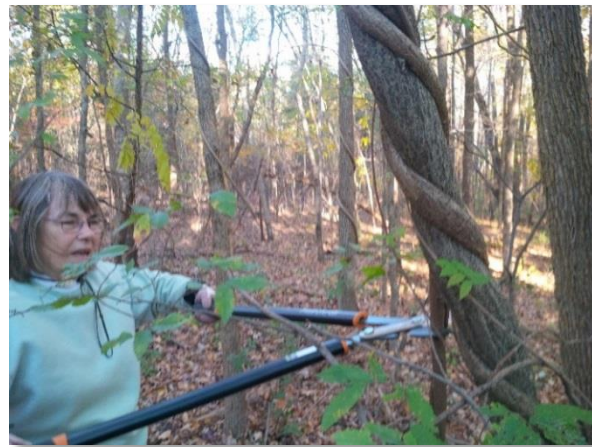
A literature review of rough-leaved loosestrife occurrence numbers revealed four Piedmont occurrences with increasing individuals and four sites with decreasing individuals between 1990 and 2015.

Steward and volunteer Activity

PCP's stewards and volunteers logged over 600 person hours across eight preserves in 2014 and then nearly doubling that in 2015 with 1175 person hours across seven preserves. Their time and efforts included ~175 stewardship site visits, volunteer workdays, and time spent on augmentation projects.



Left: Duke University students pose with invasive privet at a volunteer workday at the Hebron Road Plant Conservation Preserve.



Right: Volunteer cuts invasive wisteria at the Mineral Springs Barren Plant Conservation Preserve.

Of special note: PCP enjoys a very productive partnership with the Eno River Association in Durham County. As preserve neighbors, we have been able to collaborate on projects and share resources to meet our common goals to protect the rare plants in the Eno River Diabase Sill area. Among other things, the Eno River Association has supported and expanded PCP's volunteer pool by sponsoring multiple workdays with groups and individuals who had never heard of the Plant Conservation Program before. Similarly, our relationship with the Catawba Lands Conservancy in Gaston County has contributed significantly to our reach at Redlair. This partnership has produced volunteers for workdays at Redlair and work closely with preserve steward and previous owner Haywood Rankin.

Many of the management projects at the Durham Preserves have been enhanced with the reliable help from two volunteer stewards who travel from Wake County to participate in a variety of activities including, but not limited to, prescribed burning, trash pick-up, invasives control, seed plot

establishment, seed collection, lead guided tours, etc. Herb and Pat Amyx are continuing reintroduction efforts for smooth coneflower, tall larkspur, and smooth aster at our Durham County preserves.

Stewards at Harvest Field, Mimi Westervelt & Kathy Schlosser, continued their efforts to augment the existing Schweinitz's sunflower population, and participated in annual monitoring efforts.

Nancy Adamson continued her steward role at Denson's Creek and provided assistance in imperiled plant monitoring as well as began a site inventory to aid in our understanding of management needs. The Mineral Spring Barren volunteer steward, Lisa Tompkins, recruited and organized volunteers for the annual plant monitoring effort, a much needed task given the greater distance from PCP's central location in Raleigh, Lisa's ability to recruit local volunteers is a great asset. Lisa also led a volunteer workday to control invasive plants on the Preserve.

Plant Pathology Program

Boxwood blight

Boxwood blight is an important disease of *Buxus* (boxwood), *Pachysandra* (spurge), and *Sarcococca* (sweet box). The disease has occurred in North Carolina nurseries since October of 2011. Several nurseries experienced new infections of boxwood blight during 2015. Nurseries or nursery dealers experiencing first time detections of boxwood blight in 2015 were located in Wake, Pender, Macon and Jackson counties. In all cases, information regarding both the source of all boxwood plants and the locations to which boxwoods were sold was requested. NCDA&CS staff oversaw disposal and destruction of infected plants.

To date, nurseries and garden centers reporting box blight are located in Alleghany, Ashe, Jackson, Macon, Mecklenburg, Mitchell, Pender, Surry, Wake, and Yancey counties.

In February 2012, NCDA&CS developed an optional “Boxwood Blight Statement Program.” Under the program, a North Carolina nursery receives a statement to accompany shipments into other states. The participating nurseries are signees to a compliance agreement and follow best management practices. In addition, growers agree to monitor boxwoods for disease symptoms, and participating nurseries may be subject to extra inspections conducted by NCDA&CS. To facilitate this program, the NCSU Plant Disease and Insect Clinic assays samples collected during this process at no charge. As of December 2015, there are 71 participants in the program.

In October 2015, NCDA&CS prepared and sent a letter to statement program participants concerning the risks posed by certain activities related to the use of boxwood as cut greenery. Boxwood greenery is a common component of holiday wreaths and garlands. The process of individuals going from field to field to cut this greenery is a pathway for the spread of boxwood blight. The letter urges growers to require sanitary precautions of all greenery cutters allowed in their fields. In addition to the risks posed to nurseries by allowing people to cut greenery from their fields, using infected greenery in holiday decorations provides a pathway by which the disease can spread into home landscapes.

Export: Disease certification requirements and pathogen distribution information

Most agricultural commodities exported to foreign countries and to some U.S. states must meet certain requirements with regard to plant pests. Countries and states differ as to what is perceived as a plant pest risk. The Plant Pathologist received and handled requests from Field Specialists for assistance with interpretation of plant disease and nematode certification requirements and determination of pathogen distribution.

Specifically, new regulations imposed by the European Union to prevent the introduction of the bacterial pathogen, *Xylella fastidiosa*, have been particularly troublesome for some nurserymen. The European Union (EU) has banned entry of over two hundred plant species unless plants are produced under certain measures. The Plant Pathologist, Plant Protection Specialists, and USDA-APHIS-PPQ export staff have worked together to help nurserymen understand the requirements that will have to be met to continue exporting plants to the EU in 2016 and coming years.

Export: Tobacco blue mold oospore survey (for certification of tobacco to China)

If blue mold of tobacco occurs in a state's tobacco crop in a given year, that state must complete field surveys to detect the sexual spore stage (oospores) of the blue mold pathogen, *Peronospora tabacina*. If oospores are not detected in infected fields, the tobacco may still meet requirements for export to China. Survey procedures developed by USDA-APHIS-PPQ are required. The Plant Pathologist updates the North Carolina survey procedures yearly and sends them to the NCSU Plant Pathology Tobacco Extension Specialist for distribution to NC Cooperative Extension Service (NCCES) county personnel in the event that blue mold occurs. NCCES county agents conduct the survey by collecting samples from affected counties and submitting them to an approved lab (i.e., the NCSU Plant Disease and Insect Clinic). Industry groups pay for sample assays. Blue mold did not occur in North Carolina during 2015.

The plant pathologist met with NCSU tobacco experts, NCDA&CS personnel, USDA-APHIS-PPQ export staff and representatives from the Chinese government to discuss China's export requirements concerning blue mold. Blue mold has not occurred in North Carolina for several years, likely due to better control of the disease in tropical areas, which serve as yearly sources of inoculum. In addition, the practice of using tobacco transplants produced in Georgia and Florida has diminished over the past decade. Transplants are now produced locally in greenhouses. NCSU experts believe that these factors have contributed to a significant decrease in incidences of blue mold in North Carolina over recent years.

Export: Nematode certification

California has import requirements concerning reniform and burrowing nematodes. To assist nurseries that wish to send plants to California, Field Specialists collect soil samples and submit them to the NCDA&CS Nematode Assay lab according to procedures developed by the Plant Pathologist, who also provides oversight for this program. A sampling table based on numbers of plants or area sampled was developed by the Plant Pathologist. Using this table enables growers to pre-determine costs prior to sample collection and submission. [Note: Reniform and burrowing nematodes have not been found in any North Carolina nursery. Reniform nematode was found in eight North Carolina counties under agronomic field conditions, but burrowing nematode has never been found at any location.]

The Nematology Assay Section (NAS) Chief cooperates with the Plant Pathologist to test routine samples for soybean cyst nematode (SCN) in order to validate new-county detections. First-time detections of SCN were reported from Chatham, Anson, and Lincoln counties during 2015.

Permits: Movement of plant pathogens for research and other purposes

The USDA-APHIS-PPQ Form 526 ("Application and Permit to Move Live Plant Pests or Noxious Weeds") permits the movement of plant pathogens and other pests into North Carolina for research, diagnostic identifications, or commercial uses. The Plant Pathologist has the responsibility of adding comments to address state-specific concerns regarding each application. USDA-APHIS-PPQ issues final approval or denial of each application. All plant pathogenic organisms are subject to this requirement. The risk associated with each organism is evaluated to ensure that adequate safeguards are listed in the conditions of the permits. During 2015, sixty-four permit applications were evaluated. Pathogenic species evaluated included approximately 183 fungi/oomycetes, 25 bacteria, 16 nematodes, and 51 viruses.

Sudden Oak Death (SOD)

Surveys

Sudden Oak Death/ramorum twig and leaf blight caused by the plant pathogen *Phytophthora ramorum* is killing thousands of oak trees in California and Oregon. To prevent artificial movement out of the known infested areas, shipments of nursery host plants are regulated by federal and state quarantines. Field personnel have been involved with conducting nursery surveys and regulatory inspections for this disease since 2004. In 2015, NCDA&CS received federal Farm Bill funding to conduct surveys for *P. ramorum* and a related pathogen, *P. kernoviae*.

Visual inspections were conducted at nurseries in May and June. During September and October, big-box retail locations were inspected. A total of twenty-six (26) such sites were visited. In addition, natural vegetation was inspected and sampled at six locations. These natural vegetation survey locations were chosen based on likelihood of an epidemic spreading from a nursery into the natural environment. All natural vegetation survey sites were adjacent to nurseries, contained creeks/streams, and high-risk genera such as *Rhododendron*, *Kalmia*, and *Quercus*. Seven water samples were collected and analyzed from streams or standing water within nursery grounds, using the “bottle of bait” method.

A total of 88,505 hosts and associated plants were surveyed. Special attention was given to *Rhododendron*, *Viburnum*, *Pieris*, *Kalmia* and *Camellia*. Symptomatic plants were sampled and submitted to the plant pathologist for testing for the presence of *Phytophthora* using enzyme-linked immunosorbent assay (ELISA). Thirty-five samples were submitted of which seven were *Phytophthora* positive. *Phytophthora* positive samples included four samples from nursery surveys, and three *Camellia* leaves from water-baiting surveys.

All samples that resulted in a positive ELISA test, were sent to Kansas State University-Manhattan Diagnostic Laboratory for further diagnostics. There were no positive identifications of the target pathogens in any of the samples screened during this survey.

Recurring positive location

Ornamental plants at a nursery dealer in Mecklenburg County have tested positive for the plant pathogen, *Phytophthora ramorum*, at various times since the first detection in 2008. Plant surveys were conducted in June of 2015 at this site as part of the above-referenced, Farm Bill funded *Phytophthora* survey. All plant samples collected from the site during this survey tested negative for *P. ramorum* using molecular diagnostics. In December, two water samples were collected from standing water on the nursery grounds. A natural stream that flows directly by the nursery was also sampled, as well as three points downstream spread over several miles. All water samples tested negative for *Phytophthora ramorum*. The NCFS also conducts water sampling in the stream directly outside of the nursery as part of a USFS regional stream-baiting project. Those results are pending.

Trace-forward/trace-back notifications

USDA-APHIS-PPQ notifies NCDA&CS when a nursery in another state has plants test positive for *Phytophthora ramorum* infection. If the positive nursery has recently sent host plants to North Carolina, a trace-forward event occurs, the receiving party in North Carolina is inspected, and possible regulatory action is taken. In December of 2015, a Cabarrus County nursery was involved

in a trace-forward investigation concerning *Prunus laurocerasus* ‘Otto Luyken’ plants originating in Oregon. All *P. ramorum* host plants at the nursery were inspected and thirteen samples were collected from symptomatic plants. Of the thirteen samples collected, one tested positive for *Phytophthora* spp. using a serological assay. The sample was sent to a USDA-APHIS-PPQ accredited laboratory for molecular diagnostics and species-level testing for *P. ramorum*. The sample did not test positive for *Phytophthora ramorum* using molecular diagnostics.

Miscellaneous SOD activities

The Plant Pathologist participated in monthly, national conference calls pertaining to the Sudden Oak Death program and provided summaries to the Plant Pest Administrator. Monthly conference call participants routinely discussed issues such as: changes to national regulations, current trace-forward/trace-back investigations, updates from regulated states, on-going research, and workshop/training announcements.

Tobacco Plant Inspections

The North Carolina Tobacco Plant Certification Regulation requires anyone who moves tobacco plants into North Carolina from another state to do so under an import permit system. There were no import permit applications received during this reporting period. Another aspect of the regulation requires that plants grown in North Carolina and sold for planting in a location more than seventy-five (75) miles away from the place of production must be inspected and certified. A major reason for this requirement is to prevent the artificial movement of blue-mold or virus-infected plants from one growing region into another, which could initiate a premature disease epidemic. There were no certified tobacco plant nurseries during this reporting period.

Vegetable Plant Inspections

The Vegetable Plant Certification Regulation requires weekly inspections and certification of vegetable plants grown in North Carolina for sale to commercial growers. There were no vegetable plant nurseries certified under this regulation during this reporting period. The North Carolina Crop Improvement Association (NCCIA) certifies a large number of sweet potato cuttings and “seed” under its certification program. Because NCCIA certification requirements meet or exceed the standards of the vegetable plant regulation, NCDA&CS accepts inspections and certification tags of NCCIA in lieu of its own.

White Pine Blister Rust

White Pine Blister Rust regulations prohibit the growing of *Ribes* species (currants and gooseberries) in North Carolina because *Ribes* spp. are necessary alternate hosts to the white pine blister rust pathogen, *Cronartium ribicola*. The regulations were put in place to protect the white pine industry. Reevaluation of this regulation has been put on hold. However, work towards this end has begun and will include consultation with representatives of the NC Forest Service, US Forest Service, and NC State University as well as other state departments of agriculture that have lifted similar *Ribes* bans in recent years. Historical *Ribes* eradication efforts completed by the USFS and NCFS are being reviewed. Current information on the value and status of the white pine industry is being gathered.

Forest Pest Outreach

NCDA&CS staff delivered oral presentations to key stakeholder groups. Presentations generally covered the most imminent invasive pest threats to North Carolina forests, namely, Asian longhorned beetle, emerald ash borer, redbay ambrosia beetle/laurel wilt disease, Asian gypsy moth, and walnut twig beetle/thousand cankers disease of black walnut. Information on basic identification techniques and pest

biology was provided. In addition, participants were encouraged to report suspicious looking pests or damage to a phone number hotline or email address which NCDA&CS maintains for new pest reports from the public.

Notable presentations:

- Johnston County Master Gardeners - 35 people
- Betsy-Jeff Penn 4H camp - 12 camp counselors who reach 7,000 kids in total
- Invasive Forest Pest Workshop, advertised through the Office of Environmental Education in the Department of Environmental Quality - 35 people
- Boy Scouts, 2 separate presentations - 50 kids reached directly

In addition to oral presentations, outreach efforts took advantage of relevant public events. NCDA&CS set up booths at the NC Museum of Natural Science's "BugFest," which is attended by over 30,000 people and the NC State Fair, attended by nearly one million. Outreach efforts at the NC State Fair were paired with those of the NC Forest Service and focused on the "Don't Move Firewood" message. It is estimated that approximately 1500 individuals were reached directly through presentations and public events.

Other activities related to plant pathology

During this reporting period, the Plant Pathologist was involved with other plant disease issues. Examples include:

- Answered questions from the public as they relate to the White Pine Blister Rust Quarantine, as well as general plant problems;
- Reviewed pest lists provided by USDA-APHIS-PPQ and provided basic pathogen biology and distribution information in support of blueberry exports to the Philippines
- Continually reviewed scientific literature pertaining to new plant disease occurrences and research; expanded archive of important sources and articles for future reference
- Expanded database of *Phytophthora* species of potential concern with information such as: plant part(s) affected, symptoms, sampling methods, in order to stay abreast of future threats and ensure we sample and test for as many *Phytophthora* spp. as possible when conducting surveys
- Participated in windshield surveys for laurel wilt disease of redbay with NCFS personnel
- Participated in NC Plant Conservation Program Scientific Committee meeting to discuss the possibility of protecting the two remaining populations of federally endangered, *Lindera melissifolia*, pondberry, against laurel wilt disease using increasing monitoring and preventive fungicide applications
- Attended relevant scientific meetings/seminars including the Southern Appalachian Forest Entomology and Pathology Seminar, the NCNLA's Green n Growin' show, Laurel Wilt Conference, Coral Springs, Florida, NCPN-B Tier II meeting – Ventura, California

- Participated in quarterly meetings of the North Carolina Pest Risk Committee
- Served on the National Clean Plant Network - Berries group, Tier II board. This group meets annually and discusses funding priorities, national clean plant standard harmonization, and outreach efforts concerning micropropagation technologies and the need for clean plant standards

Regulatory Weed Program

The North Carolina Regulatory Weed Program protects North Carolina agriculture, public health, and native plant ecosystems from the harmful impacts of noxious weeds. The regulation of noxious weeds is authorized by the North Carolina Plant Pest Law and the Aquatic Weed Control Act of 1991. Program activities include inspections, issuance of Phytosanitary Certificates, issuance of Scientific Permits for movement of regulated articles and the survey, control and eradication of listed noxious weeds. The Witchweed Eradication Project, funded by USDA-APHIS-PPQ, is also a vital part of the Regulatory Weed Program. In addition, the program manager recommends justified changes to the North Carolina Administrative Code that are relevant to noxious weed listings and quarantine boundaries.

Program Accomplishment Highlights

Witchweed Eradication

- The witchweed program continues to make gains in released acres in spite of the discovery of new or re-infested fields. The total acreage of active fields (i.e. fields with fewer than 5 points) is now 1,141 acres in North Carolina.
- There were 575 acres of new or re-infested with witchweed in 2015. This highlights the need for vigilant survey, and shows the excellent work ethic of the Plant Pest Inspectors that are currently working on the witchweed eradication program.
- 1,873 acres were treated in North Carolina as part of the witchweed eradication program
- A total of 57,208 acres were surveyed to evaluate status of witchweed infestation in southeastern counties of North Carolina.

Tropical Spiderwort

- A new, significant, infestation of tropical spiderwort (*Commelina benghalensis*) was found at Claridge State Tree Nursery in Goldsboro. Eight acres were found to be infested in a loblolly pine progeny research plot. The trees were destroyed, and the plot sprayed in September 2015. An additional small site was found in Wake County, and treated with herbicide, hand roguing and fire. Monitoring of both sites will continue in 2016.

Other Noxious Weeds

- A small infestation of a Federal and State Noxious weed, Crested Floating Heart, (*Anoda cristata*) was discovered by Andrew Allen (NCDA&CS) in Guilford County in a small pond in May 2014. Herbicide applications were applied by staff from NCSU and NCDA&CS during 2014 and 2015. The population has been reduced by 95%, and should be eradicated in 2016.
- Twenty one tropical soda apple plants (*Solanum viarum*) were found during the 2015 survey at Martin Meats and Faircloth Farms in Sampson County. The plants were bagged and incinerated.
- Small broomrape (*Orobancha minor*) continues to be confined to only a few plants in several locations of Mitchell County. Annual surveys are necessary to find the plants and destroy them to prevent additional spread. A small infestation was discovered on May 23, 2012 at the Western NC Regional Livestock Center near Canton, NC. Treatment with propane burners was done in June, 2012 and herbicides were used every year since then.
- Purple loosestrife (*Lythrum salicaria*) is still confined to two general sites; Forsyth County and Henderson County. Annual surveys are necessary to find the plants and treat them with herbicide to prevent spread.

- Four sites are actively being managed for infestations of itchgrass (*Rottboellia cochinchinensis*) in Robeson County. A new site east of I-95 was discovered by Michelle Shooter (NCDA&CS) in 2014, and another new site was discovered in late 2015. Meetings with the landowners have hopefully started a partnership between NCDA&CS, NC DOT and the growers to help combat this weed. A preemergence herbicide of prodiamine was applied in early spring to help with new plants. Glyphosate was applied POST during the summer and fall of 2015 to control emerged plants and escaped plants were hand-pulled and disposed of.
- Efforts continued to evaluate efficacy of weevil releases as a biocontrol agent for mile-a-minute vine (*Persicaria perfoliata*) in Alleghany, Gates, Perquimans and Yancey counties.
- Giant hogweed (*Heracleum mantegazzianum*) has been confirmed at 6 separate sites in Watauga County. Herbicide treatment and hand-pulling were both utilized to control these infestations in 2015.
- Cogongrass (*Imperata cylindrica*) continues to be monitored in NC. There have been 3 actively managed sites, and no new plants were found there in 2015. However, late in December 2015 and new, large site was discovered in Scotland County. Plans are being made for a cooperative eradication effort between Plant Industry and NCFS.

Regulatory

- 49 phytosanitary certificates were issued to support the witchweed quarantine program. The number has decreased in recent years because of the issuance of compliance agreements with several cooperators.
- Assisted with a USDA-APHIS facility inspection of the SePRO aquatic plant research facility in Whitakers, NC with Steve Tolar (USDA-APHIS).
- The Weed Specialist visited 7 Duke Energy Coal Ash sites in May. Each site was visually inspected to ensure that no Federal or State Noxious weeds were present. This inspection was necessary in order to move forward with plans to move coal ash to other states and counties as part of remediation efforts. A final report was written and given to Mr. Don Smith, contractor with AE Com.

Public Relations and Outreach

The NCDA&CS Weed Specialist serves in an advisory role for a number of weed species in a number of workgroups. Tasks related to these responsibilities include attending numerous meetings across the state and weighing in or reporting upon the status of weed control programs. The groups are included in following list:

Committee or board member:

- NC Aquatic Weed Council
- Eno River Hydrilla Project (Outreach Committee)
- Hydrilla in the Chowan workgroup
- Lake Waccamaw Technical Advisory Group for Hydrilla management
- Aquatic Nuisance Species Workgroup
- The Weed Specialist is a member of the following Regional Weed Science Groups:

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- North Carolina Weed Science Society
- North Carolina Invasive Plant Council (also serves as Treasurer on the Board)
- South Carolina Aquatic Plant Management Society
- Weed Science Society of America

Educational talks were given to the following groups of people:

Date	Group	Location	Title of Talk	People Reached
March 03, 2015	Aquatic Weed Control Council	Raleigh, NC	EDDMaps	20
February 16, 2015	Rowland Farmers, Extension Agents	Rowland, NC	Updated Farmers on the Itchgrass situation in Robeson County	20
March 4, 2015	NCDA&CS Specialist Meeting	Greensboro, NC	An update on the Invasive Weed Control Programs in NC, and An Introduction to EDDMaps	20
March 20, 2015	Aquatic Weed Council Meeting	Raleigh, NC	An Introduction to EDDMaps	20
April 11, 2015	Chowan Edenton Environmental Group	Edenton, NC	An update on the Invasive Weed Control Programs in NC, & An Introduction to EDDMaps	15
April 14, 2015	Cape Fear Arch	Carolina Beach State Park	Invasive Plant Species: Projects, Concerns and Regulations	20
June 9th, 2015	NCFS R1 Consulting Foresters Meeting	Kinston, NC	Invasive Plant Species: Projects, Concerns and Regulations	35
August 20, 2015	NCDA&CS Regional Agronomists	Raleigh, NC	Invasive Plant Species: Projects, Concerns and Regulations	20
October 8, 2015	North Carolina Lake Management Society	Lake Waccamaw State Park	Nuisance Aquatic Weeds Identification & Status of Control in NC	20

The Weed Specialist Participated in the following Weed Science Research Meetings:

Date	Group	Location	Title of Talk	People Reached
Feb 9-12, 2015	Weed Science Society of America	Lexington, Ky	none	
March 08, 2015	North Carolina Weed Science Society	Raleigh, NC	Invasive Weeds in NC, 2015 Update	40
May 28, 2015	North Carolina Invasive Plant Council	Chapel Hill, NC	<i>Ficaria verna</i> (Fig Buttercup) - An Emerging Weed in the Southeastern U.S.	50
July 12, 2015	Aquatic Plant Management Society	Myrtle Beach, SC	<i>Ficaria verna</i> (Fig Buttercup) - An Emerging Weed in the Southeastern U.S.	

Guest Lectures were given in the following classes in 2015:

Date	Group	Location	Title of Talk	People Reached	Contact Person for Group
January 27, 2015	CS 415 - IPM Course	NCSU	Invasive Weed Program and Regulatory Issues in NC	45	David Jordan, NCSU Crop Science
February 4, 2015	CS 111 - Field Crop Production	NCSU	Invasive Plants and Regulatory	20	Bob Patterson
February 4, 2016	CS 213 - Field Crop Production	NCSU	Invasive Plants and Regulatory	40	Bob Patterson

Other Outreach Efforts:

- The Weed Specialist participated in a 4-day workshop on Weed Risk Analysis in February, hosted by APHIS-PPQ. A weed risk analysis of Japanese wisteria was developed during this time.
- The Weed Specialist also worked a booth at the Farm Show in February speaking with the public about our role in agriculture.
- A 2 hour workshop was held in Robeson County in January to educate the farmers, extension agents and Regional Agronomist about itchgrass. A management plan was discussed, contact information for all farmers was collected, and approximate locations of infestations were drawn on maps.
- Newsletter articles were written in spring 2015 and fall 2015 for the North Carolina Vegetation Management Association newsletter, and published online.
- The Weed Specialist was asked to be the official verifier for invasive plant reports in North Carolina and posted to the EDDMaps website by the general public. There were over 500 entries that needed to be approved.
- On numerous occasions, assistance was provided to help identify weeds and provide weed control recommendations in crop, turf, aquatic and non-crop sites.
- On numerous occasions, assistance was provided to recommend control methods for a particular weed problem for a citizen or farmer who requests assistance.

Invasive Plant Risk Evaluations

In April 2015, the NCDA&CS Weed Specialist collaborated with Tony Koop, of the USDA-APHIS PERAL Lab, located in Raleigh, to evaluate and publish a WRA (Weed Risk Assessment) for *Ficaria verna*. This plant, commonly called Fig Buttercup has recently been reported in several locations in North Carolina where it is becoming invasive in natural environments. The WRA took approximately 60 hours of work to complete, and the results of the WRA were presented at two research meetings. The final WRA was approved and published in August 2015 at:

https://www.aphis.usda.gov/plant_health/plant_pest_info/weeds/downloads/wra/ficaria-verna.pdf

Aquatic Dealer Inspections

Aquatic dealer inspections are completed each year by the Plant Protection Specialists. In 2015, the database organizing these inspections was in the process of being reorganized. Regular aquatic dealer inspections will resume in 2016. In the meantime, all Plant Pest Specialists inspect all registered nurseries each year, and those inspections often include aquatic plants. At any time, the Plant Pest Inspectors can report concerns to the Weed Specialist and those concerns are addressed.

General Weed Survey and Eradication Program Details

Survey Methodology and Rationale: Surveys for all projects were done by visual reconnaissance. Survey objectives are: 1) identify new infestations of target noxious weed (i.e. detection surveys); and, 2) delimit the boundaries where the weeds were mapped in previous years (i.e. delimiting surveys). Detection survey location targets were selected based on probability that subject plant pest would be present. In some instances GPS coordinates were recorded to provide reference points for mapping and relocation, if needed.

Roadsides close to wet areas and home landscapes were targets for Purple loosestrife detection surveys. Locations known to have been infested with small broomrape (*Orobanche minor*) in the past were checked several times during the summer for reoccurrence of the weed. Also, past known locations for itchgrass (*Rottboellia cochinchinensis*) were surveyed in June through October to monitor results of pre-emergent herbicide treatments applied in February 2015, and to ascertain new infestations. Cattle slaughter houses and holding farms in Sampson county are surveyed twice annually for infestations of tropical soda apple.

Since plant species must be identified during the growing season, all surveys are done during the period from full leaf (June) through the first hard freeze (usually mid-November).

Results of Active Weed Control Programs

Broomrape (*Orobanche minor*). *Orobanche minor* was discovered by Rebecca Norris and Kathy Kidd at the Western North Carolina Livestock Center near Canton, NC (Haywood County) in 2012. The infested area was burned with propane torches in 2012 to kill surface seed. The site was monitored during 2014 by Tim Hartley and James Corbin and treated as needed with a broadleaf herbicide to eliminate clover, which is a host plant of *Orobanche minor*. Approximately 15 plants were removed by hand in 2014, in a location measuring 5ft X 5ft. In 2015, Tim Hartley and James Corbin checked the site twice in May and found 120 new plants slightly uphill from the infestation in 2014. They were all removed by hand. In June 2015, about 325 plants were dug out by hand in an area of 5ft x 5ft. Repeated checks during the rest of 2015 revealed no new plants. Close monitoring of the site will continue for at least a year before it is released.

A second site, a hay field in Mitchell County is also regularly checked. No new plants were discovered in 2015.

Bushkiller (*Cayratia japonica*). Bushkiller continues to be discovered in new locations across the state, most notably in Durham and Charlotte. Current infestations are being contained by the land managers, and in some instances, where eradication is the goal, only occasional plants are found. Infestations at Reynolda Gardens, and the Old Salem Cemetery are the most extensive. While the goal at these sites is containment, NCDA&CS has not been dedicating resources to eradication of this plant at this time.

Chinese Water Spinach (*Ipomoea aquatica*). Cooperation between the APHIS-PPQ inspector, Philip Monroe, and the plant pest inspectors from NCDA&CS has continued in 2015. Several Asian markets were discovered to be selling Chinese water lettuce without an appropriate Compliance Agreements. During the summer of 2015, 10 individual compliance agreements were written for Asian Markets in Durham, Guilford, Mecklenburg, New Hanover, and Wake counties. In late summer of 2015 it was decided to discontinue these agreements due to the risk associated with importing Sweet Potato Weevil (of which, *Ipomoea aquatica* is a host plant) if the plant was grown in a state other than NC. Therefore, there are only 3 remaining active compliance agreements between NCDA&CS, and those are for North Carolina growers of *Ipomoea aquatica*.



Figure 30 *Ipomoea aquatica* being sold in an Asian market.

Cogongrass (*Imperata cylindrica*). A naturalized colony of Cogongrass was discovered for the first time in North Carolina by the Pender County Horticulture Extension Agent, Charlotte Glen in 2012. Cogongrass is considered a serious invader due to its ability to establish on a variety of soils and sites and ability to change ecosystem function by creating conditions for more frequent and hotter fires. It is a Federal and State of North Carolina Noxious Weed that continues to invade thousands of acres across the Southeastern U.S. In 2015, Plant Pest Specialists continued to monitor the existing stands of cogongrass. No new plants were discovered. Late in December of 2015, a large stand of cogongrass was discovered by an employee of the NC Forest Service in Scotland County, NC. The weed is in a pine plantation located on private property. Plans are being made to spray and burn the plants in 2016, as well as holding a training session on identification and control methods for NCDA&CS, NCFS and the Nature Conservancy.

Crested Floating Heart (*Nymphoides cristata*). Crested floating heart is established in south Florida, and was first discovered in Lake Marion, in the South Carolina Coastal Plain, in 2006. It has proven to be extremely difficult to manage in both states. The State Weed Specialist was successful in getting this plant, as well as two related species water snowflake (*N. indica*) and Yellow Floating Heart (*N. peltata*) placed on the North Carolina state noxious weed list in 2012. Crested floating heart was first discovered in North Carolina in May of 2014 in a private pond in Guilford County. Hydrothall 191 was applied by NCSU field staff in 2014 and 2015. The Weed Specialist visited the site on September 3rd, 2015 and met the homeowners. The infestation has been reduced by 95%, and Andrew Allen will continue to monitor the site in 2016.

A related species, yellow floating heart was discovered at two sites in 2015. The first is a golf course in New Bern. David Pearce is working with several homeowners to create an eradication plan for the pond in 2016 because the golf course has refused to spray herbicides. A second site was found at Lake Summit in Tuxedo, NC – reported by an employee of NC Wildlife. Sue Dial visited the site and talked with homeowners. A treatment plan was created, and then Duke Energy employees contacted us to let us know that they controlled activities on the lake and were planning to treat the plant. They worked with the homeowners association to remove the plant by hand, and will monitor plant occurrence in 2016.



Figure 32 Crested floating heart.
Guilford County, NC

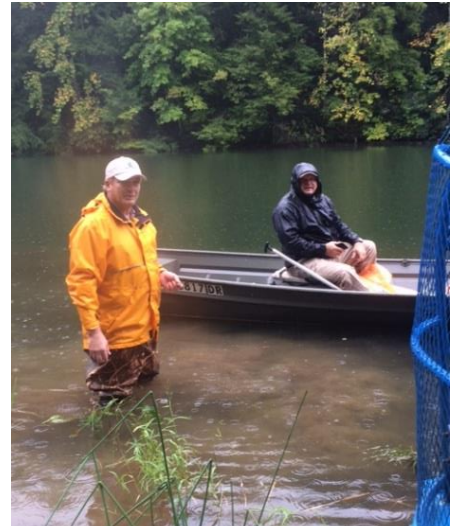


Figure 31 Hand-removal of yellow floating heart by residents of Lake Summit. Tuxedo, N.C. September, 2015. Photo courtesy of Ken Manuel, Duke Energy.

Giant Hogweed (*Heracleum mantegazzianum*). Giant Hogweed is a concern because it is a dermal sensitizer – meaning that exposure to the sap causes a skin reaction known as photodermatitis that results in large painful blisters. The plants were first officially reported in the state in 2011.

There are now six sites in Watauga County where Giant Hogweed has been located, and is being managed by Chad Taylor. Each site is visited periodically, and treated when needed. Table 17 provides a list of sites (and accompanying GPS coordinates), as well as the number of plants counted and treatment if it was needed for 2015. All plants are treated with a 3% solution of glyphosate.

Table 17 Known Giant Hogweed sites in Watauga County, Spring 2015.

Site	GPS Coordinates	2014	2015
1	36.15037, - 81.66012	No new plants have been found at this site in two years	0
2	36.13680, - 81.67685	This was the original site. 2 plants in 2014. Sprayed in June of 2014.	0
3	36.12144, - 81.74338	This was the source for the plants at site two. The check in June of 2014 yielded 37 new plants.	58 plants
4	36.11989, - 81.74354	This site was a new find in 2013. It was discovered that the plants came from site 3. They were sprayed in 2013 and no new plants were discovered in 2014.	0
5	36.11446,- 81.77836	This site was new in 2013. Origin is unknown. There were over 100 plants upon discovery. The seed heads were removed and burned and plants were sprayed. Inspection in 2014 revealed 39 new plants.	10 plants
6	36.12441,- 81.74452	New site in 2015	3 plants

Hydrilla (*Hydrilla verticillata*)

Lake Waccamaw: Hydrilla was found in Lake Waccamaw in 2012. An estimated 698 acres were infested. There are 28 rare species in the lake – including 11 mollusks, 4 fish and 13 other plants, making treatment efforts complex. Multiple state agencies banded together to put out herbicide treatments on the lake in 2014 at an estimated cost of \$486,000. Projected costs for treatment over the next 6-8 years is \$4.3M. Herbicide treatments were applied in 2014, and 2015. They have been very successful at controlling the existing vegetation and hopefully reducing the tuber bank in the soil.

Eno River: A technical committee was formed in 2013 to form a strategy for managing the Eno hydrilla infestation, and the State Weed Specialist is a member of that committee. It is estimated that \$50,000 will be needed each year for several years. Hydrilla is completely infesting all sections of the river in Eno River State Park. A public meeting was held in Hillsboro in order to present the herbicide treatment plan and answer questions. The State Weed Specialist presented a poster there answering common questions regarding the threat of AVM, a disease affecting migratory birds (including bald eagles). AVM is transmitted through algae growing on hydrilla, and thus far has been found on hydrilla growing in 3 water bodies in NC.

Herbicide treatments were applied using a drip type applicator installed on the river through a contract with SePRO Company. The treatments were ceased in early July amid concerns that the native water willow in the river was showing signs of stress. The general consensus was that the herbicide was NOT killing the water willow, but was doing a good job controlling the hydrilla.

Itchgrass (*Rottboellia cochinchinensis*). Itchgrass is a federal noxious weed, and poses problems because when touched, it can cause contact dermatitis to skin. Efforts to control this weed in Robeson County have been ongoing since the early 1980's. It was thought that the weed was eradicated in 1988, however it was detected again in the late 2000's.

Fields in Robeson County were extensively surveyed in 2011 to indicate infested areas. Approximately 1,700 acres were surveyed and treatments of glyphosate were applied along field borders and ditches where standard weed control practices were not implemented by the growers to maintain soybean and corn crops. Surveys indicated 57 fields (totaling 1,090 acres without itchgrass) and 35 fields (600 acres) with spots of itchgrass mainly along field edges and in rights-of-ways.

A farmer meeting was held at the fire department in Rowland, NC on February 16, 2015. Sixteen farmers, extension agents and NCDA&CS employees were in attendance. The situation was discussed, everyone looked at maps of past and present infestations, and talked about a plan for treatment moving forward. It was agreed that the NC DOT will coordinate with Plant Pest Specialist Michelle Shooter and Bridget Lassiter to put out pre and post-emergent herbicides, while the farmers will be responsible for controlling the infestations in their own fields.



Figure 33 Public Itchgrass meeting, Rowland Fire Department, February 2015.



Figure 34. NCDOT signs posted at each itchgrass site, March 2015.

Five roadside itchgrass sites were treated with a PRE application of prodiamine herbicide on March 17, 2015 by Kevin Clemmer of the NC DOT. Good control was achieved at all sites except for the Chicken Road site. The NC DOT also agreed to post "Do Not Mow or Spray" roadside signs at each of the 4 sites to encourage DOT contractors and farmers to avoid the areas. Seeds are likely moved around through equipment, and contract mowers are thought to have contaminated the Williams Pond Road Site in 2013.

Post emergence glyphosate applications were made by both Michelle and local farmer, Kay McGirt, throughout the growing season when plants were located. Plants with seed heads were hand pulled and disposed of in plastic bags.

In September 2015, the roadside sites were scouted by Michelle, Bridget and Justin Karl. GPS coordinates were collected. An additional infestation was discovered, and several other spots were also noted. The new sites are being collated into maps with the old sites so that the herbicide sprays can be tracked. Justin is creating maps of the infestations using ArcGIS.



Figure 35 NCDOT employee spraying herbicide for Itchgrass control, March 2015.

Table 18 Known Itchgrass sites in Robeson County, surveyed in Spring 2015.

Loc	Name	County	City	GPS Coordinates
1	Blue Pate Rd	Robeson County	Rowland	34.5477, -79.2829
2	Williams Pond Rd	Robeson County	Rowland	34.5046, -79.2922
3	Chicken Rd	Robeson County	Rowland	34.602, -79.1842
4	New Rd	Robeson County	Rowland	34.5046, -79.2922

Also, in September, the Williams Pond Road site was visited by USDA APHIS employees and NCDA&CS employees to discuss the control program currently in place for this plant.

Cooperation between DOT, NCDA&CS and Robeson County farmers is ongoing to detect and control infestations of itchgrass.

Mile-a-minute vine (*Persicaria perfoliata*)

Mile-a-minute (MAM) vine is documented in the following North Carolina counties: Alleghany, Gates, Guilford, Pasquotank, Perquimans, Rockingham, Watauga and Yancey counties. A population was found along the Mayo River in Mayo River State Park, downstream from a known infestation. During 2014 Park Superintendent Keith Martin recorded several more populations along the river.

Since 2011, biological control of MAM weed has been underway in North Carolina under the supervision of Kathy Kidd (NCDA&CS). On May 7th 2015, MAM weevils were released in Gates and Perquimans counties in an area where they were also released in 2014. The weevils had become well established and were already feeding on MAM vine. On July 17th the MAM sites were observed in Rockingham County. On August 6th additional MAM weevils were released in



Figure 36 NCDA&CS employees release MAM weevils in Perquimans County, May 2015.

Rockingham County. Extensive surveying of existing sites was done, and several additional sites were located along the Mayo River in Mayodan. In September a survey was completed in Allegheny County. The general consensus is that the weevils are going a good job of reducing leaf area on the MAM plant, but the MAM plant is also growing in more sites than ever.



Figure 37 Confirmed reports of Mile-A-Minute Vine in North Carolina, 2015.

Oriental bittersweet (*Celastrus orbiculatus*)

Farmers markets in Asheville, Greensboro and Raleigh were inspected for Oriental Bittersweet in 2015, but only one seller was found at the Saturday Dixie Classic Fairground Farmers Market. Andrew Allen made contact with the vendor and issued a stop sale for the items.

A survey was conducted for the presence of Oriental Bittersweet in counties outside of the current quarantine counties (Figure 38). Results are shown in Table 19.



Figure 38 Quarantined counties where movement and sale of Oriental Bittersweet is allowed.

Table 19 Known Oriental Bittersweet sites by County, Fall 2015.

County	Location	GPS Coordinates	Specialist
Forsyth	Forsyth 1	(36.0881196, -80.3737534),	Andrew Allen
	Forsyth 2	(36.106714, -80.265963)	Andrew Allen
Guilford	Price Park	(36.1059331, -79.8820411)	Andrew Allen
	Sedgefield	(36.0120977, -79.8801136)	Andrew Allen
Surry	Elkin	36.26591, -80.84273	Ginger Hemmings
	Dobson	36.35042, -80.68881	Ginger Hemmings
	Lowgap	36.53181, -80.86713	Ginger Hemmings
	Lowgap	36.54007, -80.87881	Ginger Hemmings
Yadkin	Jonesville	36.25025, -80.82080	Ginger Hemmings
	Arlington	36.23497, -80.81623	Ginger Hemmings
	Boonville	36.26847, -80.72224	Ginger Hemmings

Purple Loosestrife (*Lythrum salicaria*)

Purple loosestrife is a federal noxious weed. It is prevalent in riparian areas, and displaces native vegetation. It has an attractive purple flower, and was thought to have been intentionally planted in North Carolina. Eradication efforts have been ongoing for almost 20 years. There are two main areas that are in the process of being eradicated.

Site 1 – Guilford County:

Sixteen sites are located near Winston-Salem (Table 20). The first three sites below are the most heavily infested, but eradication efforts have greatly reduced the number of plants present in 2015. Site 5 (Oak Grove Church Rd) is likely to be the original site, and there have been no plants there for 3 years. Site 16, a golf course, is managed by the golf course personnel and monitored by Andrew Allen. Plants were surveyed and treated on three dates in 2015 (May, July and September). The flower heads were clipped and removed in garbage bags, and the remaining plants were treated with a 1.5% solution of Element 3A (triclopyr). The sites will continue to be monitored in 2016, with herbicide treatments made as necessary.

Table 20 Purple loosestrife sites and acreages treated near Winston-Salem, NC.

Site	GPS Latitude	GPS Longitude	Acres	Treatment Dates		
				May 28, 2015	July 9 2015	Sept 17, 2015
				-----Plants Found -----		
I-40 West	36.07042893	-80.15678182	4.51	many	50	
Rec Center	36.07213056	-80.15496865	2.03	many	0	
Substation	36.07111048	-80.15596175	7.66	many	10	
Farmingdale	36.08209177	-80.15750794	1.71	20	5	
Oak Grove Church Rd	36.08275462	-80.1357344	0	0		
Megahertz	36.05817098	-80.17106929	1.97	0	0	
Krispy Kreme	36.0562938	-80.17078946	0.79	3	0	
Corning Plant	36.05567246	-80.17498931	2.05	1	1	
Goose Pond	36.0535053	-80.18703683	7.83	0	0	
Chaucer Lane	36.05043841	-80.18960097	3.82	2	8	
Fox Meadow	36.0357447	-80.19275031	1.75	0	0	
Villas	36.04122216	-80.20579241	0.57	0	0	
1-40 East Pasture	36.0686042	-80.1563407	1.46	0	10	
Wallburg	35.9975458,	-80.0930742	2.23	1	0	
Little White Church	36.04627997	-80.19543131	0.85	0	0	
Willshire Golf Course	36.017487	-80.259329	3.32	2	0	

Site 2 - Henderson County:

Purple loosestrife was also discovered in 2011 in Henderson County, and is being monitored by Sue Dial of NCDA&CS. Five separate sites are being treated (Table 21) – one occupying several acres at the Henderson County airport. The site was discovered by a stewardship biologist with the NC Wildlife Resources Commission. The second site (across the road from the airport) encompasses 20 acres; which includes two soybean fields, an alley between the fields, and the City of Hendersonville sewer line right-of-way.

Table 21 Purple loosestrife sites and acreages treated in Henderson County, NC.

Site	Acres	--- Status Report ---
Airport (ditches)	1	Fewer plants
Large Soybean Field	8-10	Large plants along both edges
Small soybean field	2-3	Fewer plants along long edges, but majority located along north edge. Many large plants in woods.
Home on Beverly Rd	>1	One plant located just inside chain link fence
Sewer Alley	>1	Fewer plants than before, no large plants, just small new plants along the path.
Roadside	>1	Many large plants. DOT mower there mowing plants. Plants contained in the area between the bridge and curve at the garage on both sides of the road.

Herbicide treatments at the site are ongoing, and on June 29th, 2015 the entire area was scouted and sprayed with a treatment of glyphosate. A follow-up treatment was made in September where the blooming tops were cut and sprayed, as well as a basal treatment to all of the remaining plants. Additional follow-up treatments will be made in 2016.

Tropical Soda Apple (*Solanum viarum*)

Tropical Soda Apple is a concern because the plants are large and spiny. Cattle prefer to eat the fruits, and thus the seeds are spread wherever cattle are moved in from areas where this weed is common (i.e. Florida). It has been managed for several years at two sites in North Carolina, under the supervision of Herbie Ward.

On July 13th and October 15th 2015, both Faircloth Farm and Martin Meats were surveyed (Table 22). The plant found at Martin Meats was a large plant with unripe fruit. The plant was found in a wooded area of pasture behind Mr. Martin's house. The plants found at the Faircloth Farm ranged from small (6 inches) to large (24 inches). Some large plants did have unripe fruit on them. Eleven plants were found in the wooded area of the long pasture to the east of the corral, and 9 plants were found in the wooded area to the south of the corral area. All plants were pulled and disposed of in paper yard waste bags and incinerated.

Survey efforts at both of these sites will continue in 2016.

Table 22 Tropical Soda Apple survey sites, Sampson County.

Date	Location	Acres	Fields	Plants Found	Survey Crew
July 13 2015	Martin Meats	10	1	0	Herbie
July 13 2016	Faircloth Farm	30	1	0	Herbie (Spot Check)
October 15 2015	Martin Meats	260	26	1	Cleveland, Earl, Herbie, James, Richard
October 15 2015	Faircloth Farm	850	8	20	Cleveland, Earl, Herbie, James, Richard
Totals		1150	36	21 Plants	

Tropical Spiderwort (*Commelina benghalensis*)

Tropical Spiderwort is a federal noxious weed, and has several methods of reproduction, including underground flowers and tubers. Propagation of this plant can occur from stem cuttings, seed or tubers. Several locations of the plant have been found in North Carolina since 2001, but the quarantine area is currently confined to two locations in Wayne County, NC (one additional added in 2015). The quarantine for Tropical Spiderwort remains active at the Cherry Research Farm near Goldsboro (Site 1). An additional quarantine was established at Claridge State Nursery in Goldsboro NC in August 2015 (Site 2). A third site (Site 3) was discovered in Raleigh and is under treatment for eradication.

Site 1: Tropical Spiderwort was found in a conventional field in September 2014. That field was fumigated in November 2015, and is now being monitored by Ann Gallagher (NCDA&CS). This field was planted to corn for silage, and totaled 13 acres. The field remained fallow in 2015, and was monitored for weed growth. A survey of the dairy pastures was conducted by Ann Gallagher on September 9th, 2015 to eliminate the possibility of TSW seed harvested from the corn field, and fed as silage to the dairy cows living at Cherry Research Farm. No TSW plants were found in the pastures.

In March 2015, Emerald Ash Borer (EAB) was discovered at Cherry Research Farm. The infestation was contained to one field plot (~2.5 acres) of ash trees that were planted in 2000. Trees were planted on an 8x12 grid = 453 trees per acre. On March 30th and 31st, each tree in the infested plot was cut down by a chainsaw crew from the NC Forest Service, and burned by employees of Cherry Research Station. All sanitation protocols for reducing the spread of Tropical Spiderwort were followed by each worker on the site, and enforced by the Weed Specialist.



Figure 39 Sanitation of chain saws used in tropical spiderwort infested areas. March 2015.

Site 2: On August 21st, Claridge State Nursery employee James West alerted NCDA&CS to the discovery of Tropical Spiderwort in a field of Loblolly Pines. A significant portion of the 8-acre field was found to be infested with TSW. On September 2nd, the remaining fields at the nursery were surveyed for the presence of TSW, and found to be clean. The positive field was sprayed with Gramoxone that day, and burned with fire on September 3rd. After burning, the field was bush hogged and disked to eliminate any remaining biomass. A total of 10 other fields were identified that were located at private landowner farms, where equipment and employees from Claridge had worked. Each of these sites (located in Bertie, Bladen, Moore, Granville, Harnett, Person, Randolph, Scotland, Wake, and Wayne counties) were visited in September by either Ann Gallagher or Bridget Lassiter and the appropriate NCDA&CS Plant Pest inspector. All fields were found to be negative for presence of TSW.

Site 3: On Friday September 11th, an NCSU student alerted NCDA&CS to the presence of TSW in a private apartment complex in Raleigh, NC near the NCSU campus. A sample was collected and confirmed by Alexander Krings (NCSU Herbarium). On September 16th, 5 NCDA&CS employees visited the site and hand rogued out the small patch of plants (measuring ~15 ft. x 15ft.), and disposed of them in an incinerator. The site was then sterilized using a propane burner. On October 16th, a herbicide application of Dual Magnum and Roundup was applied to the site. The site will continue to be monitored for several years to ensure eradication. An adjoining storm drain was also identified, and surveys are planned for 2016 to determine that the plant has not been moved downstream via the storm drain.



Figure 40 Hand roguing a small patch of Tropical Spiderwort, Raleigh, NC September 2015.

Cherry Research Farm Visitor Logs: All visitors to the Cherry Research Station are asked to sign in at the Tropical Spiderwort Quarantine area, and keep a log of visits to the wash station. Ann Gallagher, NCDA&CS Eastern Region Supervisor reported the data shown in Table 23 for the quarantine log.

Table 23 Tropical Spiderwort quarantine visitor sign-ins and wash station log, 2015.

Month	Visitor Sign-Ins	Wash Stations Log
January	36	2
February	43	2
March	153	122
April	211	226
May	127	198
June	244	144
July	281	123
August	99	126
September	128	162
October	209	0
November	89	0
December	0	0
Total Sign-Ins	1,620	1,105

Ann Gallagher also responds to the Station Manager when equipment from the farm will be leaving Cherry Research Station for use on other stations, or when equipment is sold to a new owner. She conducted 12 inspections of equipment leaving the farm, and 17 fumigations (using Methyl Bromide) of equipment.

Giant Salvinia (*Salvinia molesta*)

Giant Salvinia, a Federal Noxious Weed, was detected at an aquatic nursery display at the North Carolina State Fair in 1998, and subsequent surveys by NCDA&CS, NCDENR, and NCSU personnel resulted in detections in 26 counties in North Carolina. All of these infestations have been eradicated. However, in September 2000, naturalized infestations of Giant Salvinia were detected in golf course ponds in New Hanover County and in a canal and wetland at the Riverbend near Burgaw in Pender County. Acting under the authority of the Aquatic Weed Control Act of 1991, NCDENR Water Resources personnel began herbicide treatments at these sites in November, 2000. A survey of the Northeast Cape Fear River and adjacent wetlands at the Pender County site in 2005 and 2007 yielded no new finds of Giant Salvinia. Survey and monitoring of the River Bend site in Pender County has continued to the present.

A biological control program for Giant Salvinia at the Pender County site was initiated in 2004 with two releases of the Salvinia Weevil (*Cyrtobagous salviniae*) in June and September. Observations throughout 2005 confirmed the successful overwintering and survival of the Salvinia Weevil in Pender County, but this biocontrol effort was not deemed appropriate as we approached eradication of this plant and the biocontrol program was discontinued in 2008.

The current status of Giant Salvinia in NC is that there are no known populations. The Giant Salvinia Task Force is still consulted for technical advice on program activities, but the NC Department of Environmental Quality and the NCDA&CS work together to monitor the situation. Past locations were gathered from Mr. Wayne Batten in 2015, and a broad survey is planned for 2016 to determine eradication status.

Witchweed (*Striga asiatica*)

Witchweed (*Striga asiatica*) is a Federal Noxious Weed and a Class A State Noxious Weed in North Carolina. It is an obligate parasite, and needs a grassy host such as corn, sorghum, millet, rice and several other warm season grasses. Heavy infestations of witchweed can eliminate yield from these crops, resulting in devastating economic losses. The presence of this quarantined pest also imposes a regulatory burden on crop production and on the movement of farm commodities, equipment, and other regulated articles. The witchweed eradication program includes an organized and effective set of survey, control and regulatory procedures developed through early USDA, APHIS research.

Specific objectives of the program include: 1) characterization of the infestation through survey; 2) control of existing infestations; and, 3) containment by preventing the movement of potentially infested articles out of established quarantine boundaries.

Survey – Survey is necessary to detect and verify the extent of witchweed (Detection and Delimiting surveys), evaluate the effectiveness of eradication treatments on infested properties (Appraisal surveys), and verify eradication of witchweed on sites released from quarantine (Released surveys). Additional survey of terminated acreage is required in order to confirm the long-term effectiveness of the eradication program. Survey is done through the growing season after host plants have started to grow from about the middle of June through the end of October or until the first frost.

Control – The objective of control treatments is to prevent witchweed seed production and eliminate witchweed seed from the soil. Herbicide treatments, hand pulling and disking help to control witchweed host plants and witchweed plants before they can flower and produce seed. Ethylene applications also help to deplete soil reserves of witchweed seed by encouraging germination and subsequent control by exposure to treatments or a non-host crop. Control treatments can be completed during the growing season and into the winter months provided soil moisture and temperature are favorable for soil fumigation.

Regulatory – Regulatory activities aid in preventing the artificial spread of witchweed from infested areas to non-infested sites. These regulatory functions facilitate the interstate and intrastate movement of agricultural commodities from witchweed regulated areas



Figure 41 Witchweed in flower in an idle field, Cumberland County, NC September 2015.

Witchweed Eradication Program Data Compilation Description

A point system was developed for the program that provides a quantitative measure for moving fields from infested to a released status and from a released status to a terminated status. All control treatments and surveys are tracked in an *Access* database that automatically updates the point values for released fields and tracks assigned point values for infested fields. New or re-infested fields are added to the infested field list when witchweed is confirmed in new fields or in fields that have been previously released. The points assigned to infested fields are determined by the nature of the field and the control activities that were completed during the season. Once a field accrues five points it is advanced to “Release” status which means it is surveyed for a minimum of 10 years on a predetermined schedule that includes some skip years and either a spot survey or survey of the whole field (general survey) in the other years. A spot survey qualifies the field for 0.5 points and a general survey qualifies the field for 1.0 points. Once a field acquires a total of 10 points, of which 5 are assigned during the 10-year release survey period, it is terminated from the program.

The following summary tables show the status of acreage in North Carolina as of the end of survey and treatment for the current growing season which usually occurs by mid-November each year. Since point values for a field are adjusted only once at the end of the growing season, it is not possible to obtain an accurate end of season account of field status until survey and treatment have ended for the year.

The following is a description of steps used to compile year-end summaries from the *Access* data base:

- Based on input from each inspector, infested field point values are manually adjusted to reflect current field conditions and treatments that were done during the year. In most instances, fields will be advanced in point value. Some fields may qualify for release based on reaching a point value of 5. Infested field point value at the end of the season is a judgment based on knowledge of witchweed biology, field treatments and current field conditions. The new field point values are assigned at the end of the growing season after the first frost when it is assumed no more treatments for the year will be implemented and no new witchweed will be found.
- New fields are added to the data base and are assigned a new farm and/or field number. Re-infested field point values are changed to bring them back to values less than 5 so that they will be tallied as infested fields.
- After end of growing season adjustments, the data base is queried and standard reports are generated to provide updated statistics for acreages infested, released, surveyed and treated.

2015 Witchweed Program Discussion

We had an average spring and early summer field season this year, however mid-summer was unusually dry and this slowed the growth of both crops and witchweed. The fall was wet and rainy, and some farmers struggled to get their crops harvested. The first killing frost happened in late October, and the last field surveys for witchweed were completed during the last week of October, so we feel fairly certain that we controlled any flowering witchweed in our active fields. During the field season (May through October), active fields were visited and treated every 10-12 days instead of every 21 days, thereby eliminating much of the risk that witchweed would flower and produce more seed. In addition, ethylene was more frequently applied by hand to treat known witchweed spots in the hope this will help to deplete seed in isolated spots in active fields.

To date, the data show a slight increase in the number of acres infested from 1,135 in 2014, to 1,141 in 2015 (Table 25). Five counties remain in the witchweed quarantine program (Bladen, Cumberland, Pender, Robeson and Sampson). Eighty two farms with 118 fields are actively being scouted in these five counties. Plant pest inspectors treated 1,873 acres with disking, ethylene, hand pulling, and herbicide treatments in 2015 (Table 28). Acres that were surveyed in 2015 totaled 57,208 – which is a decrease from 2014 when 77,736 acres were surveyed (Table 29). Forty nine phytosanitary certificates were issued for commodities being sold from the counties in the Witchweed Quarantine counties (Table 31).

Several fields (equaling 575 acres), previously released or terminated fields were discovered to be re-infested with witchweed. There are several ways that the fields could have been re-infested (contamination from equipment on the farm, movement of contaminated articles, or a long-lived seed bank), and we attribute the very astute actions of the plant pest inspectors in finding the fields. In many cases, the inspectors stop to look at fields that have been released from the program (therefore not requiring a formal inspection) when they happen to be in the area inspecting other active fields. This situation emphasizes that this eradication program takes many years to be successful due to the very long seed viability (>15 years), and that prematurely ending the program could result in many new re-infested fields.

Witchweed seed will remain viable in the soil for ten years and up to 20 years, and will germinate only when conditions are right and hosts are present. Fumigation with Methyl Bromide ceased due to new EPA regulations, so our only control measures are the use of ethylene to promote germination, use of glyphosate to control witchweed in the row crops, use of glyphosate to control weedy hosts (crabgrass) on field edges, disking, and hand-pulling.



Figure 42 NCDA&CS Witchweed staff, Bladen County, September 2015.

(L to R) Bridget Lassiter, Carlie Averitt, James Bullard, Richard Smith, Cleveland Chavis, Earl Brewington and Justin Karl.

an excellent job of learning the *Access* database and coordinating with each member of the witchweed team to ensure consistent data collection procedures. In August, the position of Plant Pest Aide (previously held by Mr. Bullard) was filled by Mr. Carlie Averitt. Mr. Averitt is a lifelong resident of the Fayetteville area, and is familiar with the witchweed program because his family farm participated in the program in past years.

Several personnel changes were made in the witchweed program in 2015. Mr. Robert Cooper, a plant pest inspector in the Fayetteville work unit, retired at the age of 80 in January 2015. He had 11 years of service with the witchweed program. His position was filled in March by Mr. James Bullard, who had previously filled the position of Plant Pest Aide in the Fayetteville unit, and has worked on the witchweed program for 14 years. We feel confident that this unit remains in good hands

because of the vast amount of knowledge that Mr. Bullard retains from his years working under the guidance of Mr. Cooper. The position of processing assistant was vacated in December of 2014, and filled in April of 2015 with Mr. Justin Karl. Justin has done an

On September 9th, 2015 we hosted a field tour of the witchweed program for visitors from USDA-APHIS in Riverdale, MD, and Raleigh, NC. Approximately 15 employees of USDA and NCDA&CS participated in the tour. The plant pest inspectors were very helpful in identifying fields with active witchweed infestations, and talking at each stop about the control measures being implemented in each instance.



Figure 43 NCDA&CS employee Earl Brewington explains the Witchweed program to USDA employees in Bladen County, September 2015.

The Weed Specialist and several Plant Pest Inspectors in the witchweed program spent some time with employees of the North Carolina Crop Improvement Association (NCCIA) to train them on the witchweed eradication program. The NCCIA inspected several corn and soybean fields in the summer of 2015 to ensure that they were “Witchweed Free” in order to write the proper paperwork for seed export to Argentina.

On October 19th and 20th, 2015 the Raleigh, NC unit of USDA-APHIS and NCDA&CS hosted a delegation of 5 people from Argentina who were interested in the witchweed program due to import/export restrictions that their country have imposed upon seed shipments from the United States. The group visited field sites in South Carolina and North Carolina on Monday October 19th where they were able to view live witchweed plants in the field. On Tuesday October 20th, the group spent the morning participating in a workshop about the history of the witchweed program, as well as the biology of the plant. In the afternoon, the group toured the NCDA&CS soil lab where they learned about the soil sterilization techniques that are used when soil samples are collected from active witchweed fields.

A non-cooperator who is a homeowner in Cumberland County denied Plant Pest Inspectors access to her land in May of 2015. NCDA&CS employees sent a certified letter to the homeowner stating the reasons why regular inspections were necessary on her garden plot. On July 21st the Weed Specialist and Plant Pest Inspector met with the NCDA&CS law enforcement officer to conduct an inspection of the field. The homeowner did not respond to phone calls or inquiries at her residence. Later in the field season she tilled the plot. Regular inspections of the field revealed no live witchweed plants for the duration of 2015.

Efforts in 2016 will continue to monitor infested fields, but also to scout fields in counties that were released from the program 10 to 15 years ago. Our efforts to monitor these fields will hopefully reveal that control efforts have been effective.

Table 24 Infested acreage by point value and county for 2014 and 2015







County		0-0.9 Acres	1-1.9 Acres	2-2.9 Acres	3-3.9 Acres	4-4.9 Acres	Infested Acres	
Bladen	2014	183.60	100.60	149.30	64.40	53.20	551.10	
	2015	104.50	128.70	196.30	52.60	48.80	530.90	
Cumberland	2014	71.20	0	10.90	73.10	170.40	325.60	
	2015	80.50	3.30	0	24.90	169.20	277.90	
Pender	2014	0	6.00	2.50	0	0	8.50	
	2015	0	0	6.00	2.50	0	8.50	
Robeson	2014	8.70	0	0	0	223.80	232.50	
	2015	134.60	2.30	13.10	97.30	60.00	307.30	
Sampson	2014	0	0	12.30	0	4.30	16.60	
	2015	0	0	12.30	12.30	4.00	16.30	
Total	2014	263.50	106.60	175.00	137.50	451.70	1,134.50	
	2015	319.60	134.30	215.40	189.60	282.00	1140.90	

Table 25 Number of infested farms and fields by county.







County		No. of Farms	No. of Fields	Infested Acres	
Bladen	2014	36	57	551.10	
	2015	34	55	530.90	
Cumberland	2014	35	43	325.60	
	2015	32	41	277.90	
Pender	2014	1	2	8.50	
	2015	1	2	8.50	
Robeson	2014	14	19	232.50	
	2015	12	17	307.30	
Sampson	2014	4	4	16.60	
	2015	3	3	16.30	
Total	2014	90	125	1,134.30	
	2015	82	118	1,140.90	

Table 26 Released acreage by point value and county for 2014 and 2015.

County		5-5.9 Acres	6-6.9 Acres	7-7.9 Acres	8-8.9 Acres	9-9.9 Acres	Released Acres	
Bladen	2014	159.70	31.50	41.70	587.40	579.10	1,399.40	↓
	2015	88.80	105.60	47.20	413.30	423.40	1,078.30	
Columbus	2014	0	0	0	0	85.30	85.30	↓
	2015	0	0	0	0	48.80	48.80	
Cumberland	2014	507.20	11.10	196.50	339.20	451.70	1,505.70	↓
	2015	226.60	328.30	68.00	336.60	288.90	1,248.40	
Pender	2014	45.50	0	0	0	2.50	48.00	↓
	2015	40.90	4.60	0	0	0	45.50	
Robeson	2014	143.10	14.70	144.20	235.20	1,406.60	1,943.80	↓
	2015	72.30	121.90	118.50	132.20	1,009.70	1,454.60	
Sampson	2014	18.80	0	14.70	32.40	202.30	268.20	↓
	2015	3.70	15.40	11.00	36.10	111.10	177.30	
Total	2014	874.30	57.30	347.10	1,194.20	2,727.50	5,250.40	↓
	2015	432.30	575.80	244.70	918.20	1,881.90	4,052.90	

Table 27 Summary of treated acreage by crop type for 2014 and 2015.

Crop Name		No. of Acres Treated
Corn	2014	604.55
	2015	910.30
Soybean	2014	539.90
	2015	97.40
Idle	2014	836.00
	2015	558.35
Other	2014	566.86
	2015	307.13
Total Crop Acres Treated		
	2014	2,547.31
	2015	1,873.18

Table 28 Summary of acres by treatment type.

Treatment Type		No. of Acres Treated	No. of Treatments
Disking Treatment Code 39	2014	787.00	107
	2015	721.80	84
Ethylene (Tractor & Hand) Treatment Code 43	2014	432.52	76
	2015	305.68	37
Hand Pulled Treatment Code 61	2014	286.78	250
	2015	541.40	201
Herbicide to Host Treatment Code 94	2014	967.30	73
	2015	349.30	27
Herbicide to Witchweed Treatment Code 95	2014	44.11	25
	2015	13.30	7
Herbicide (Survey Aid) Treatment Code 96	2014	29.60	7
	2015	0	0
Total Acres Treated	2014	2,547.31	538
	2015	1,931.48	356

Table 29 Summary of surveyed acreage.







Category		Total Acres	
Appraisal	2014	10,140.80	
	2015	8,399.00	
Release	2014	19,809.80	
	2015	13,600.40	
Delimiting	2014	42,423.50	
	2015	30,690.80	
Detection	2014	5,361.70	
	2015	4,437.90	
Regulatory	2014	0	
	2015	80.00	
Total Acres Surveyed	2014	77,735.80	
	2015	57,208.10	

Table 30 Witchweed program acreage status

	2014	2015
Total Acres in Infested Category	1,134.30	1,140.90
Total Acres in Released Category	5,250.40	4,052.90
Total Acres Managed by Program	6,384.70	5,193.80
Total Acres Treated	2,547.31	1,873.18
Total Acres Surveyed	77,735.80	57,208.10
Acres Transferred from Infested to Release Category	287.50	166.60
Acres New or Re-Infested	<u>- 176.00</u>	<u>- 574.90</u>
Net Gain in Eradicated Acres	111.50	-408.30
Acres transferred from Release to Terminated Category	2,231.40	1,324.3

Table 31 Other Witchweed program statistics.

	2014	2015
Acres Treated by Contract	0	0
Counties now Infested in NC	5	5
Number of Witchweed Bounty Payments	12	4
Associated Witchweed Bounty Acreage	137.2	27.10
Number of Witchweed Infested Fields with Witchweed Sightings	65	82
Total Number of Witchweed Observations	209	204
Number of Phytosanitary Certificates Issued	77	49

The following maps contain GPS collected data points for counties containing quarantined Witchweed fields. Data points were collected in 2014.

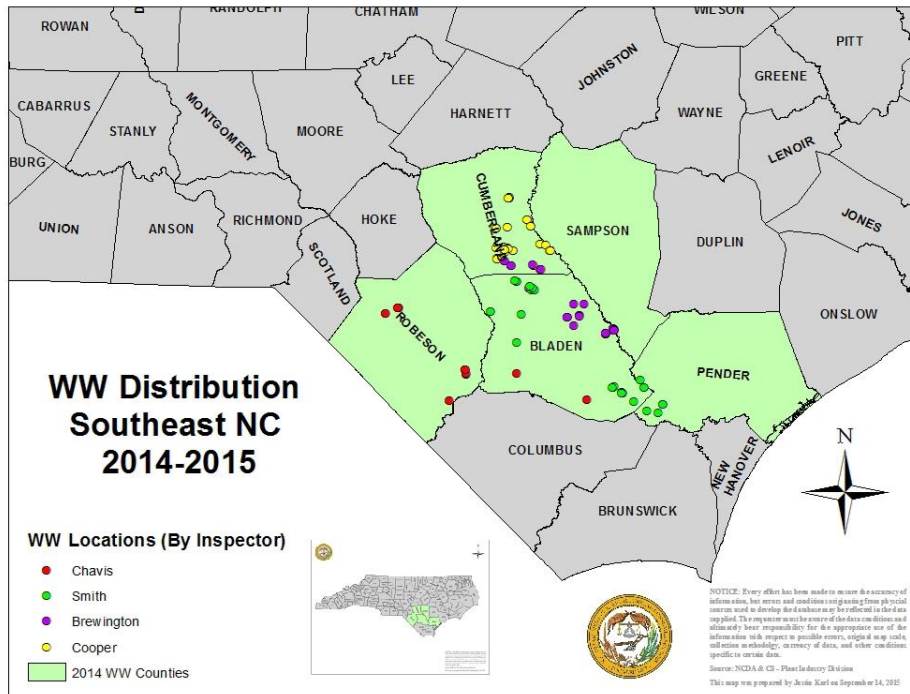


Figure 44 Witchweed distribution in North Carolina by County and Inspector.

ACCOMPLISHMENTS: SEED AND FERTILIZER SECTION

The mission of the Seed and Fertilizer Section is to improve the profitability and sustainability of agriculture in the state by ensuring the seed, fertilizer, lime, and other soil additives offered for sale in North Carolina meet prescribed standards and are properly labeled.

The mission of this section is accomplished by:

- Ensuring that all locations that offer seed, commercial fertilizers, agricultural liming materials, landplaster, and soil additives for sale in the state are registered.
- Implementing a sound regulatory compliance program by conducting inspections and sampling of seed and fertilizer offered for sale in the state.
- Implementing seed purity, germination, and other specialized laboratory tests in support of the seed regulatory and service programs.
- Implementing a joint federal/state administered biotechnology permitting and inspection program.
- Conducting the fertilizer bioassay and endophyte testing programs.
- Coordinating activities of the N.C. Seed Board such that complaints regarding the failure of agricultural or vegetable seed to produce or perform as labeled or warranted are heard and responses are provided.

The Seed and Fertilizer Section includes 25 staff members with responsibilities and accountability for administration, field services and North Carolina Seed Lab functions. The total budget for the Seed and Fertilizer Program for 2014-15 was \$1,627,026 including a state appropriation of \$667,769 and receipts of \$959,257. Revenues included receipts from licenses, registration fees, and tonnage fees.

Seed and Fertilizer Field Programs

During the fiscal year 2014-15 the Seed and Fertilizer Section remained very active providing services to producers and individuals within North Carolina and some service to non-residents of the state. Administrative staff was responsible for issuing 4,446 licenses for business that sold wholesale and retail seed. During the 2014-15 fiscal year 6,041 fertilizer licenses were issued to companies manufacturing or distributing fertilizer products. These products were sold through chain and private retail outlets and through 216 farm supply outlets.

Seed and Fertilizer Field Staff are responsible for conducting inspections and sampling seed and fertilizer offered for sale in the state. The staff also implements a regulatory program to ensure full compliance with laws and regulations. An overview of program accomplishments is provided in Table 32.

Seed and Fertilizer Field Staff also provided support to the North Carolina Department of Transportation by collecting 274 samples from 34 seed lots to be utilized on highway projects. The lab tests performed on these seed lots detected several violations and as such remain a critical part of the program.

Table 32 Seed and Fertilizer Program Inspection and Regulatory Activities, FY 2014-15

Number of Seed and Fertilizer Dealer Visits:	5,560
Seed and Fertilizer Samples collected	
Official Seed Samples	2,160 (50,034 lots)
Official Fertilizer/Lime Samples	1,850 (31,940 lots)
Regulatory Compliance Program	
Seed Stop Sales Issued	38
Seed Stop Sales Issued and Resolved on Site	1,344
Seed Stop Sales (N.C. Seed Lab)	188
Fertilizer Stop Sales Issued	12
Fertilizer Stop Sales Issued and Resolved on Site:	40

Table 33 and Table 34 provide additional information on fertilizer and lime samples taken by field staff and subsequently analyzed to ensure compliance with applicable statutes and regulations.

Table 33 Data of fertilizer samples analyzed for the current and previous fiscal years

FERTILIZER SAMPLING AND TONNAGE						
Year	#Samples	#Compliant	%Compliant	Tonnage Reported	Tonnage Sampled	%Sampled
2014-15	1,081	730	67.53	1,497,209	18,862	1.25
2013-14	1,374	1,058	77.00	1,509,378	22,309	1.48
2012-13	1,228	868	70.68	1,378,111	21,920	1.59
2011-12	1,195	876	73.31	1,243,164	56,762	1.50
2010-11	1,437	1,019	70.90	1,295,362	33,170	2.56
2009-10	1,651	1,141	69.11	1,251,026	26,539	2.12
2008-09	1,484	1,069	72.52	1,073,286	35,598	3.32

Table 34 Data of lime and landplaster samples analyzed for current and previous fiscal years.

LIME SAMPLING AND TONNAGE						
Year	#Samples	#Compliant	%Compliant	Tonnage Reported	Tonnage Sampled	%Sampled
2014-15	587	510	86.88	741,188	28,757	3.88
2013-14	646	498	77.00	831,854	28,620	3.44
2012-13	692	615	88.87	825,596	33,941	4.11
2011-12	758	541	71.37	767,766	36,965	4.80
2010-11	895	724	80.90	793,925	43,680	5.50
2009-10	729	611	83.81	640,106	35,793	5.59
2008-09	871	720	82.66	687,605	43,295	6.30

N.C. Seed Laboratory

The North Carolina Seed Laboratory is responsible for providing laboratory support for both the regulatory and service areas including the state's seed dealers, producers, university researchers and consumers. The work of this laboratory provides critical seed testing data needed to make management decisions regarding seed stock and for labeling purposes. For 2014-15, the North Carolina Seed Laboratory conducted 3,025 regulatory seed tests and 10,790 service seed tests. These tests involve required testing for purity and germination. Multiple tests are generally conducted on each of the samples submitted with 13,815 individual tests carried out. Additional special tests included tetrazolium, accelerated aging, cool test of cotton, cold test of hybrid corn, phenol, Round-up Ready™ tolerance, sand, and moisture testing. There were 541 special tests conducted during the fiscal year. All official regulatory samples taken during the fiscal year 2014-15 represent testing for a total of 57,507,587 pounds of seed offered for sale in North Carolina. See Figure 45 and Figure 46 for more information on the various seed tests performed in the laboratory.

The Seed and Fertilizer Section continued to implement the endophyte testing service. A number of grasses, including tall fescue and perennial ryegrass, contain a fungal endophyte which has a beneficial relationship with the grass host. The tall fescue endophyte, *Neotyphodium coenophialum* (previously *Acremonium coenophialum*), lives exclusively inside plants, and can only be detected through laboratory analysis. This endophyte has been proven to give the plant insect, disease and drought resistance, as well as enabling the plant to be more tolerant of overgrazing. Though very beneficial to tall fescue plants, this endophyte produces chemicals which are toxic to a variety of animals. In North Carolina, fescue toxicosis is especially a problem in horses and cattle. A total of 28 pasture samples were processed for producers, both in-state and out-of-state.

The staff of the North Carolina Seed Laboratory remains active in the Association of Official Seed Analysts and the Association of American Seed Control Officials. At the state level, program staff remains active in the North Carolina Seedsmen's Association and the North Carolina Crop Improvement Association.

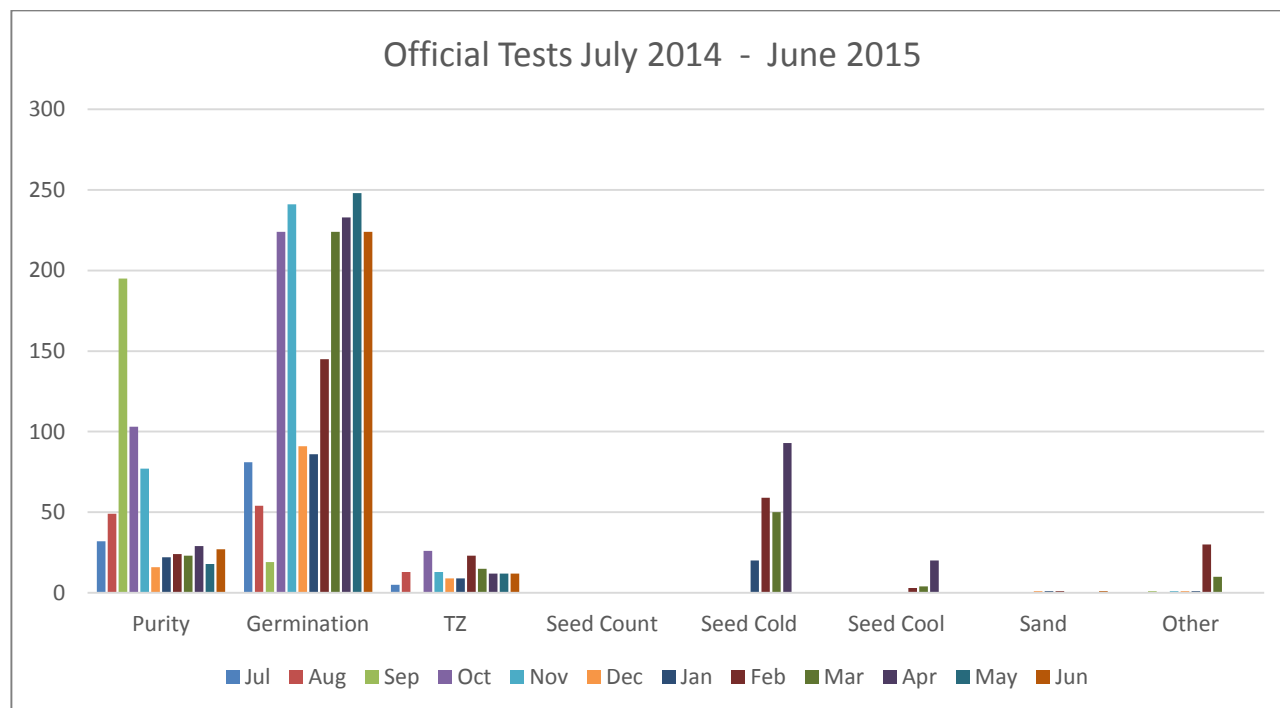


Figure 45 Seed Laboratory official tests.

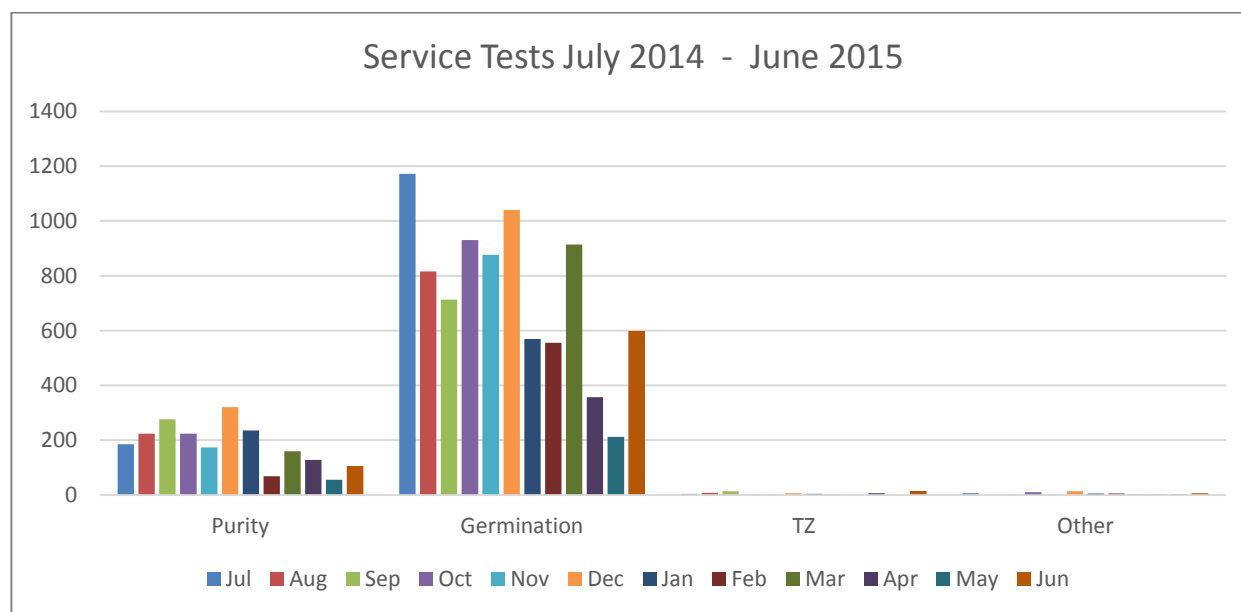


Figure 46 Seed Laboratory service tests.

Joint Collaboration with USDA, Biotechnology Regulatory Services

Seed and Fertilizer Section staff worked with USDA, Biotechnology and Regulatory Services (BRS) to jointly administer a federal/state biotechnology and permitting program. Primary responsibilities included reviewing permits and acknowledgements provided through USDA-BRS for laboratory, greenhouse, and field tests of genetically engineered crops. For this period, NCDA&CS staff reviewed a total of 292 notifications and permits. A joint project with USDA-BRS continued during this period involving NCDA&CS staff conducting field inspections of *Notification and Permit Release Sites*, including pharmaceutical/industrial trials. During this time period there were 6 field inspections conducted by NCDA&CS field staff. As a prerequisite for participation in the project, all field staff were required to participate in training conducted by USDA-BRS focusing on work flow, confidential business information, and steps in effectively completing a field inspection.

North Carolina Seed Board

The responsibility of the North Carolina Seed Board is to review complaints from individuals who may have suffered damage from the failure of agricultural or vegetable seed to perform as labeled or warranted, or as a result of negligence. Performance issues related to seed purity, seed germination, varietal purity, percent weeds, inert material, other crop seed and test date are potential issues to be addressed by the Seed Board. For the 2014-15 fiscal year time period, 14 complaints were filed with the Seed Board for tobacco seed and 1 complaint was filed for carrot seed.

North Carolina Tobacco Variety Evaluation Program

The Tobacco Variety Evaluation Program continued in joint cooperation with N.C. State University. Samples from 39 flue-cured tobacco seed lots were obtained for planting grow-outs in the variety testing program. The Tobacco Seed Committee approved for sale in North Carolina a total of 66 different varieties from four different seed companies. The Tobacco Seed Committee declined to approve one variety proposed to be offered for sale in the 2015 growing season.